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CONTRIBUTIONS TO THE MOSQUITO FAUNA OF SOUTHEAST ASIA. XII.

ILLUSTRATED KEYS TO THE GENERA OF MOSQUITOES (DIPTERA, CULICIDAE)

By
Peter F. Mattingly

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ILLUSTRATED KEYS TO THE GENERA OF MOSQUITOES[1]

By

Peter F. Mattingly[2]

INTRODUCTION

The suprageneric and generic classification adopted here follow closely the Synoptic Catalog of the Mosquitoes of the World (Stone et al., 1959) and the various supplements (Stone, 1961, 1963, 1967, 1970). Changes in generic nomenclature arising from the publication of the Catalog include the substitution of *Mansonia* for *Taeniorhynchus* and *Culiseta* for *Theobaldia*, bringing New and Old World practice into line, the substitution of *Toxorhynchites* for *Megarhinus* and *Malaya* for *Harpagomyia*, the suppression of the diaeresis in *Aëdes*, *Aëdeomyia* (formerly *Aëdomyia*) and *Paraëdes* (Christophers, 1960b) and the inclusion of the last named as a subgenus of *Aedes* (Mattingly, 1958). The only new generic name to appear since the publication of the Catalog is *Galindomyia* (Stone & Barreto, 1969). *Mimomyia*, previously treated as a subgenus of *Ficalbia*, is here treated, in combination with subgenera *Etorleptiomyia* and *Ravenalites*, as a separate genus. Ronderos & Bachmann (1963a) proposed to treat *Mansonia* and *Coquillettidia* as separate genera and they have been followed by Stone (1967, 1970) and others. I cannot accept this and they are here retained in the single genus *Mansonia*.

It will be seen that the treatment adopted here, as always with mosquitoes since the early days, is conservative. Inevitably, therefore, difficulties arise in connection with occasional aberrant species. In order to avoid split, or unduly prolix, couplets I have preferred, in nearly every case, to deal with these in the Notes to the Keys. The latter are consequently to be regarded as very much a part of the keys themselves and should be constantly borne in mind. A bibliography of key works is included for the benefit of those who may wish to carry out identification at the subgeneric or species level.

DISEASE RELATIONS AND BIONOMICS

Disease Relations

Setting aside mechanical transmission and phoresy, mosquitoes serve as vectors of three groups of human pathogens. These are Haemosporidia (four species of human malaria parasite and an occasional simian malaria parasite, all belonging to the genus *Plasmodium*), two or more species of Filarioidea belonging to the genera *Brugia* and *Wuchereria*, and the arboviruses, of which more than 40 have been recovered from man and another 40 are believed to infect man on the evidence of antibody surveys. The diseases to which these give rise are discussed as ecological systems by Mattingly (1969). Monographs or reviews dealing with particular groups of diseases include Edeson & Wilson (1964), Garnham (1966), Reeves (1965), Russell et al. (1963), Taylor (1967), Berge et al. (1970) and Ward & Scanlon (1970). For epidemiology and epidemiological sampling methods see Detinova (1968), Muirhead-Thomson (1968) and Pampana (1969). For control methods see Busvine (1966).

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Human malaria is transmitted exclusively by *Anopheles* spp. Vectors include *An. labranchiae* Falleroni, *sacharovi* Favre, *sergentii* (Theobald), *superpictus* Grassi and *pharoensis* Theobald in parts of the Mediterranean area, *An. funestus* Giles, *moucheti* Evans, *nili* (Theobald) and members of the *gambiae* Giles complex in the Ethiopian Region, *An. stephensi* Liston, *fluviatilis* James and *pulcherrimus* Theobald in western Asia, *An. culicifacies* Giles in India and Ceylon, *An. maculatus* Theobald, *sundaicus* (Rodenwaldt) and members of the *An. barbirostris* Van der Wulp, *hyrcanus* (Pallas), *umbrosus* (Theobald), *leucosphyrus* Dönitz, *minimus* Theobald and *annularis* Van der Wulp groups in southern Asia, members of the *An. punctulatus* complex in Melanesia and *An. pseudopunctipennis* Theobald, *bellator* Dyar & Knab, *cruzii* Dyar & Knab, *darlingi* Root, *aquasalis* Curry, *albimanus* Wiedemann, *albitarsis* Lynch Arribalzaga and *nuneztovari* Gabaldon in Central and South America. Other species may be locally important and in general a list such as the above can present only a very crude picture since the importance of a particular vector in a given area will vary with the prevailing ecological conditions (see, e.g. Reid in Ward & Scanlon, 1970). Complicating factors include the development of insecticide resistance among a number of important vectors (World Health Organization, 1970) and the habit of some others of feeding and resting outside houses where they fail to make contact with the insecticide. (For behavioral aspects see Mattingly, 1962b). Vectors of wuchererian filariasis include several of the major malaria vectors and, in addition, the highly domestic *Culex pipiens fatigans* Wiedemann throughout the tropics except in the Pacific area where the nocturnal periodicity of the parasite is suppressed and day-biting vectors, particularly *Aedes (Stegomyia) polynesiensis* Marks, take over. Vectors of brugian filariasis include *Anopheles* and *Mansonia* spp. (See Wharton, 1962, Edeson & Wilson, 1964, Reid, 1968).

Viruses known or believed to infect man have been recovered from more than 150 species of mosquitoes belonging to 14 different genera (*Aedeomyia, Aedes, Anopheles, Culex, Culiseta, Deinocerites, Eretmapodites, Haemagogus, Limatus, Mansonia, Psorophora, Sabethes, Trichoprosopon, Wyeomyia).*

Bionomics

The egg stage, though of cardinal ecological importance, has been somewhat neglected. The nearest to a general review will be found in Mattingly (Riv. Parassit., in press). Oviposition sites (or larval breeding places) may be roughly classified as follows:

A. Running water habitats (stream edges, mainly anophelines).
B. Still water habitats.
    1. Ground water habitats
        a. Permanent (anophelines and culicines other than *Aedes* and aedine genera).
        b. Temporary (especially *Aedes*).
        c. Specialized (crab holes, rock holes, wells, soak aways) (various culicines, a few anophelines in wells).
    2. Container habitats (artifacts, tree holes, cut, split or bored bamboos, leaf axils, plant pitchers, flower petals, bracts, spathes, fallen leaves or rachids, fruits and husks, snail shells, cup fungi etc.) (*Toxorhynchites, Anopheles* subgenus *Kerteszia,* sabethine genera, some aedine genera, some subgenera of *Aedes,*

individual species and species groups of *Anopheles* and various culicine genera).

Larval bionomics are reviewed in the various taxonomic monographs listed on p. 37, notably Hopkins (1952), and by Laird (1956). Since the introduction of residual insecticides a quarter of a century ago adult bionomics have received increasing attention. Coverage in taxonomic monographs is not always adequate. Exceptions are Gillies & de Meillon (1968) and Reid (1968). Among general reviews Bates (1949) and Muirhead-Thomson (1951) are classics, the former recently republished. Horsfall (1955) is a compilation useful mainly for references to earlier literature. Marshall (1938) has enjoyed great popularity as an elementary introduction and has also been recently republished. Natvig (1948) contains much information regarding northern species. Clements (1963) covers a much wider spectrum than the title might suggest. Mattingly (Riv. Parassit., in press) summarizes a wide range of topics and has an extensive and up-to-date bibliography. Publications on bionomics of individual vectors include Christophers (1960a), Jachowski (1954) and de Meillon et al. (1967). Wharton (1962) covers various aspects of Old World *Mansonia* spp. Literature on Neotropical species is scattered. Galindo et al. (1950) and Trapido & Galindo (1957) will serve as an introduction.

The role of diel rhythms in cyclical behavior has received much attention but there is no general review. Mattingly (Trans. 13th internat. Congr. Ent., in press) reviews some ecological implications. Haddow (1955) discusses techniques for recording and analyzing biting cycles. More fundamental work has been concerned chiefly with the oviposition cycle. Gillett (1962) is a key paper for the modus operandi of the internal 'clock'. More recently this type of study has been extended to the diel activity rhythm (Taylor & Jones, 1969).

Interest in mosquito genetics stemmed mainly from the development of insecticide resistance but many other aspects of mosquito biology are now involved. The field as a whole is well covered by Wright & Pal (1967).

GEOGRAPHICAL DISTRIBUTION

Outline distributions are given in the Synoptic Catalog. For further details see the various regional monographs listed below. Mattingly (1962a) discusses mosquito zoogeography in general. For zoogeography of the Pacific area see Belkin (1962, 1968).

FAMILY CULICIDAE

KEYS TO THE GENERA

I. FEMALES

1. Proboscis long, strongly attenuated and recurved with prominent setulae confined to base; posterior edge of wing emarginated just beyond tip of vein Cu2 (Fig. 1) (Subfamily Toxorhynchitinae) . . . . *Toxorhynchites* Theobald[5]

Fig. 1. *Toxorhynchites splendens* (Wiedemann), a. female head, b. male head, c. wing.

Proboscis and wing otherwise 2

2. Abdomen with sterna (and usually also terga) wholly or largely devoid of scales (Subfamily Anophelinae) 3

Abdominal terga and sterna with dense, uniform covering of scales (Subfamily Culicinae) 5

3. Veins Cu1 and M, distad of the cross vein, wavy (Fig. 2); all wing scales dark; Moluccas, Melanesia and northern Australia only . . . . *Bironella* Theobald

Fig. 2. *Bironella hollandi* Taylor, wing.

These veins very rarely wavy; if so then wing with conspicuous pattern of light and dark scales[1]* 4

4. Scutellum trilobed with bristles in 3 distinct groups (Fig. 3a); posterior pronotal bristles present (Fig. 4); New World tropics only . . . . *Chagasia* Cruz

Fig. 3. Thorax in dorsal view, a. *Chagasia fajardoi* (Lutz); b. *Anopheles balabacensis* Baisas; c. *Wyeomyia aporonoma* Dyar & Knab; d. *Trichoprosopon digitatum* (Rondani). *apn* anterior pronotum, *p* postnotum, *s* scutum, *sc* scutellum.

Fig. 4. Generalized mosquito thorax in lateral view showing setae used in the keys. *1 me* lower mesepimeral, *pa* prealar, *ppn* posterior pronotal, *psp* postspiracular, *sp* spiracular.

Scutellum smoothly rounded with bristles more or less evenly distributed (Fig. 3b); posterior pronotal bristles absent . . . . *Anopheles* Meigen

5. Tip of proboscis swollen, upturned and hairy (Fig. 5); Old World tropics only . . . . *Malaya* Leicester[2,3,5]

Fig. 5. *Malaya genurostris* Leicester, female head.

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* Superscript, here and elsewhere, refers to "Notes on the Keys" p. 29.

Proboscis sometimes with tip swollen, otherwise unmodified 6

6. Scutum with double median longitudinal stripe of broad, flat, usually white or silvery, scales; spiracular bristles present, postspiraculars absent (see Fig. 4); Southeast Asia and New Guinea only . . . . *Topomyia* Leicester[2,3,5]
Without this combination of characters 7

7. Squama and postnotum bare; vein 1A reaching wing margin at most very slightly beyond base of fork of vein Cu (Fig. 6a) 8

Fig. 6. *Hodgesia malayi* Leicester, a. wing, b. outstanding scales from outer half of wing field. *al* alula, *c* costa, *sc* subcosta, *sq* squama, *st* stem vein.

Squama fringed at least in part (Fig. 14a, b, d) or postnotum with bristles (Fig. 3c, d) or vein 1A reaching wing margin well beyond the base of fork of vein Cu (Fig. 13) or with any combination of these characters 10

8. Outstanding scales on outer half of wing field with emarginated tips (Fig. 6b); Old World tropics only . . . . *Hodgesia* Theobald[2]
Wing scales otherwise; distribution various 9

9. Pleuron with conspicuous vertical stripe of broad, silvery scales extending from the prealar area to mid coxa (Fig. 7); wing membrane with microtrichia visible under magnification of about 50x; Southeast Asia only . . . . *Zeugnomyia* Leicester[2]

Fig. 7. Thorax in side view, *Zeugnomyia gracilis* Leicester.

Pleural ornamentation otherwise; microtrichia minute, visible only under high mangification . . . . *Uranotaenia* Lynch Arribalzaga[2]

10. Spiracular area with scales or one or more bristles (Fig. 4) 11
Spiracular area bare 18

11. At most 1 or 2 prealar bristles present (see Fig. 4); stem vein and base of subcosta without bristles (see Fig. 6a); Oriental and Australasian Regions and far eastern Palaearctic only . . . . . . *Tripteroides* Giles[5,6]
Prealar bristles more numerous; stem vein, at least, with bristles or genera confined to New World 12

12. Postspiracular bristles absent; abdomen blunt tipped; prealar bristles relatively numerous; bristles present dorsally on stem vein and, usually, also

ventrally at base of subcosta; Nearctic Region and Old World only . . . . *Culiseta* Felt[4]
Without this combination of characters; New World species only 13

13. Postspiracular bristles present; postnotum bare; abdomen pointed at tip . . . . *Psorophora* Robineau-Desvoidy
Postspiracular bristles absent; postnotum usually with a tuft of setulae (Fig. 3c, d); abdomen blunt tipped 14

14. Spiracular area with broad scales only, without bristles; proboscis shorter than fore femur; scutal scales with gold and purple metallic reflections; pleura with abundant golden and silvery scales; hind tarsus with only 1 claw . . . . *Limatus* Theobald
Spiracular area with 1 or more small bristles (Fig. 4); proboscis and thoracic ornamentation various; hind tarsus with 2 claws as usual 15

15. Antenna at most about half the length of the proboscis, usually less; proboscis long and slender, at least one-sixth as long again as fore femur (as in Fig. 16c); scutum covered with broad, flat scales; scutellum with silvery scales at least on part of mid lobe; one or more tarsi nearly always with white markings on one side at least. . . . . *Phoniomyia* Theobald[7]
Without this combination of characters 16

16. Scutum covered with flat, metallic scales with bright iridescent reflection; prealar bristles absent (see Fig. 4); anterior pronotal lobes large, almost touching in mid line; one or more tarsi often with conspicuous "paddles" of erect scales (Fig. 8a) . . . . *Sabethes* Robineau-Desvoidy[8]

Fig. 8. a. mid leg, *Sabethes belisarioi* Neiva; b, c. base of wing, b. *Wyeomyia moerbista* (Dyar & Knab); c. *Trichoprosopon pallidiventer* (Lutz).

Without this combination of characters; tarsi never with "paddles" 17

17. Anterior pronotal lobes large and closely approximated (Fig. 3c); squama bare or with 1-3 bristles or hairlike scales arising from the upper portion near the alula (Fig. 8b); clypeus sometimes with scales, never with setulae . . . *Wyeomyia* Theobald
Pronotal lobes smaller, well separated (Fig. 3d) or squama with bristles more numerous or arising from lower portion (Fig. 8c) or clypeus with conspicuous setulae or with any combination of these characters. . . *Trichoprosopon* Theobald

18. Antenna short, thick, tapering, basal flagellomere with a prominent scale tuft; mid and hind femora with large tufts of sub-erect scales at apex (Fig. 9a, c) . . . . *Aedeomyia* Theobald

Fig. 9. *Aedeomyia catasticta* Knab, a. female antenna, b. male antenna, c. hind femur.

Antenna and femora otherwise 19

19. Antenna with flagellomeres short and thick and verticillary hairs unusually short; vertex and occiput with numerous short hairs (Fig. 10a, b); New Zealand only. . . . . *Opifex* Hutton

Fig. 10. Head of *Opifex fuscus* Hutton, a. female, b. male.

Head quite otherwise 20

20. Postnotum with a small patch of setulae (as in Fig. 3c, d) or scutum covered with flat scales with bright metallic reflection, usually both; southern and eastern Asia only. . . . . *Heizmannia* Ludlow[9]

Postnotum without setulae or distribution otherwise 21

21. Scutum covered with broad, flat scales with bright metallic reflection; anterior pronotal lobes unusually large; New World tropics and subtropics only. . . . . *Haemagogus* Williston

Scutal ornamentation otherwise; anterior pronotal lobes not unusually large 22

22. Antenna unusually long, exceeding the proboscis by about the length of the last 4 flagellomeres or more; first flagellomere greatly elongated, 3 or more times as long as the terminal flagellomere (Fig. 11a); proboscis not noticeably swollen apically; New World only . . . . . . *Deinocerites* Theobald

Fig. 11. Antenna, palp and proboscis, *Deinocerites cancer* Theobald, a. female, b. male; *Galindomyia leei* Stone & Barreto, c. female, d. male; *Ficalbia minima* Theobald, e. female.

Without this combination of characters 23

23. Antenna longer than proboscis with all flagellomeres markedly elongated, apical flagellomere at least half as long as the basal one (Fig. 11c); proboscis distinctly swollen apically; scutum without conspicuous ornamentation; postspiracular bristles absent; tarsi unbanded; New World tropics only. . . . . *Galindomyia* Stone & Barreto[10]

Without this combination of characters 24

24. First fore and mid tarsomere distinctly longer than the other 4 together; fourth tarsomere shorter than fifth, only a little longer than broad (Fig. 15b); (postspiracular bristles absent; all claws simple) . . . . . . *Orthopodomyia* Theobald
Proportions of these tarsomeres otherwise 25

25. Postspiracular bristles present or fore tarsal claws toothed or both 26
Postspiracular bristles absent; all tarsal claws simple 30

26. Paratergite broad and bare; postnotum usually with a group of setulae (as in Fig. 3c, d); back of head, pleura and posterolateral corners of abdominal terga with broad, silvery scales; tropical Africa only. . . . . . *Eretmapodites* Theobald
Without this combination of characters 27

27. Decumbent scales of vertex broad, flat; postspiracular and lower mesepimeral bristles present and proboscis curved and laterally compressed (Fig. 12a) or postspiraculars absent and palpus half length of proboscis or more; southern Asia, Japan and Melanesia only . . . *Armigeres* Theobald[11]

Fig. 12. *Armigeres (Armigeres) subalbatus* (Coquillett); antenna, palp and proboscis, a. female, b. male.

Proboscis otherwise; postspiracular bristles present 28

28. Upper surface of wing with all or most scales very broad, many often asymmetrical (Fig. 13); all tarsal claws simple; decumbent scales of vertex narrow . . . . *Mansonia* Blanchard (part)[12]

Fig. 13. *Mansonia (Mansonioides) uniformis* (Theobald); wing.

Without this combination of characters 29

29. Squama bare or with at most 6 short hairs (Fig. 14a); alula with broad scales; posterior pronotum without scales; pleural scales restricted to 4 small white spots; those on sternopleuron and mesepimeron sometimes fused; hind tarsomeres II-IV with conspicuous white basal bands; Southeast Asia only . . . . *Udaya* Thurman

Fig. 14. Base of wing, a. *Udaya lucaris* Macdonald & Mattingly; b. *Mimomyia (Etorleptiomyia) luzonensis* (Ludlow); c. *Mimomyia (Ravenalites) deguzmanae* (Mattingly); d. *Mansonia (Coquillettidia) crassipes* (Van der Wulp).

Without this combination of characters . . . . *Aedes* Meigen[13]

30. Small or very small species; alula with fringe of narrow scales; antenna with first flagellomere at least twice as long as fifth, usually longer; palpus less than one-fifth length of proboscis; scutellum with narrow scales only; wing with anterior fork cell less than twice as long as its stem; Old World tropics only . . . . *Ficalbia* Theobald[14]
Without this combination of characters 31

31. Alula bare or with flat, decumbent scales (Fig. 14b, c); Old World tropics only . . *Mimomyia* Theobald[14, 15]
Alula with narrow fringe scales (Fig. 14d) 32

32. Hind tarsal claws very small and inconspicuous; all tarsi with well developed pulvilli (Fig. 15a) . . . . *Culex* Linnaeus

Fig. 15. a. *Culex* sp., apex of hind tarsus; b. *Orthopodomyia anopheloides* (Giles), mid tarsus.

Hind tarsal claws not unusually small; pulvilli absent . . . . *Mansonia* Blanchard (part)[16]

II. MALES[17]

1. Proboscis long, strongly attenuated and recurved with prominent setulae confined to base; posterior edge of wing emarginated just beyond tip of vein Cu2; palps of the same order of length as the proboscis (Fig. 1b, c) (Subfamily Toxorhynchitinae) . . . . *Toxorhynchites* Theobald[5]
Proboscis and wing otherwise; palps various 2

2. Abdominal sterna wholly or largely bare; scutellum evenly rounded, not trilobed (Fig. 3b); fore tarsus with a single claw only 3
Without this combination of characters 4

3. Veins Cu1 and M, distad of the cross vein, wavy (Fig. 2); all wing scales dark; palps various; Moluccas, Melanesia and northern Australia only . . . . *Bironella* Theobald
These veins wavy only in a few species with brightly ornamented wing[1]; palps at least three-quarters of the length of the proboscis, usually longer . . . . *Anopheles* Meigen

4. Abdomen devoid of scales; fore tarsi with paired claws; New World only . . . . *Chagasia* Cruz
Abdomen densely scaly. 5

5. Proboscis strongly modified, as in the female (Fig. 5); Old World tropics only . . *Malaya* Leicester[2,3,5]
Proboscis otherwise 6

6. Scutum with double median stripe of broad, flat scales; spiracular bristles present; postspiraculars absent; palps minute, as in female; Southeast Asia and New Guinea only . . . . *Topomyia* Leicester[2,3,5]
Without this combination of characters 7

7. Squama bare; vein 1A reaching wing margin at most very slightly beyond base of fork of vein Cu (Fig. 6a); palps minute, as in female 8
Squama fringed, at least in part (Fig. 14a-c), or vein 1A reaching wing margin well beyond this or both; palps various 10

8. Outstanding scales on distal half of wing emarginated at tips (Fig. 6b); antenna as in female, non-plumose and with all flagellomeres, including the last 2, subequal . . . . *Hodgesia* Theobald[2]
Wing scales otherwise; antennae various 9

9. Pleuron with conspicuous vertical stripe of broad, silvery scales (Fig. 7); 1 fore and 1 mid claw toothed . . . . *Zeugnomyia* Leicester[2]
Pleuron otherwise; fore and usually also mid claws both simple. . . . . *Uranotaenia* Lynch Arribalzaga[2,18]

10. Spiracular area with scales or 1 or more bristles (Fig. 4) 11
Spiracular area bare 18

11. Prealar bristles numerous (Fig. 4); postspiracular bristles absent; bristles present dorsally on stem vein and usually also ventrally at base of subcosta (see Fig. 6); palps at most slightly shorter than proboscis; Nearctic Region and Old World only . . . . *Culiseta* Felt[4]
Without this combination of characters and distribution 12

12. Old World only. *Tripteroides* Giles[5,6]
New World only 13

13. Postspiracular bristles present; postnotum bare; palps longer than proboscis . . *Psorophora* Robineau-Desvoidy
Postspiracular bristles absent; postnotum normally with a tuft of setulae (Fig. 3c, d); palps often only a quarter of the length of the proboscis or less 14

14. Proboscis shorter than antenna, and with a conspicuous scale tuft at tip (Fig. 16a), or with an abrupt flexure beyond half way (Fig. 16b); palps minute as in female; scutal scales with gold and purple metallic reflection . . . . *Limatus* Theobald

Fig. 16. Male antenna, palp and proboscis. a. *Limatus asulleptus* (Theobald); b. *Limatus durhamii* Theobald; c. *Phoniomyia davisi* Lane & Cerqueira; d. *Trichoprosopon perturbans* (Williston).

Proboscis otherwise; palps and scutal ornamentation various 15

15. Palps about a quarter of the length of the proboscis or less; antenna at most about half the length of the proboscis, usually less; proboscis long and slender, at least about one-sixth as long again as fore femur (Fig. 16c); scutum covered with broad, flat, often metallic scales; scutellum with silvery scales on part of mid lobe at least; one or more tarsi nearly always with white markings . . . . *Phoniomyia* Theobald[19]

Without this combination of characters 16

16. Palps less than a quarter of the length of the proboscis; scutum with broad scales with bright, iridescent, metallic reflection; one or more pairs of legs often with conspicuous "paddles" (as in Fig. 8a); prealar bristles absent (see Fig. 4); anterior pronotal lobes very large, almost touching in mid line . . . . *Sabethes* Robineau-Desvoidy[20]

Without this combination of characters; legs never with "paddles" 17

17. Palps usually more than half the length of the proboscis; if not then either scutum with narrow scales or proboscis long and slender and antenna much more than half the length of the proboscis with the 2 terminal flagellomeres greatly elongated (Fig. 16d). . . . . *Trichoprosopon* Theobald[21]

Palps at most about a quarter of the length of the proboscis, usually less; scutum covered with broad, flat scales; antennae various but never with the 2 terminal flagellomeres greatly elongated . . . . . . *Wyeomyia* Theobald[19, 20]

18. Antenna with the 2 terminal flagellomeres markedly thickened (Fig. 9b); hind femur with a large apical scale tuft (Fig. 9c); palps very short, as in female. . . . . *Aedeomyia* Theobald

Antenna and hind femur otherwise; palps various 19

19. Antenna with flagellomeres 2-4 each with a stout dorsal spine; back of head with numerous short hairs; palps with apex clavate (Fig. 10b); New Zealand only . . . . *Opifex* Hutton
Antenna, palps and back of head quite otherwise 20

20. Palps at most about one-fifth of the length of the proboscis; scutum covered with broad, flat scales with bright, metallic reflection or postnotum with a group of setulae (as in Fig. 3c, d) or both; antenna usually with verticillary hairs short as in female (Fig. 17a); southern and eastern Asia only . . . . *Heizmannia* Ludlow[22]

Fig. 17. a. *Heizmannia scintillans* Ludlow, male antenna, palp and proboscis; b. *Galindomyia leei* Stone & Barreto, male fore tarsal claws.

Without this combination of characters 21

21. Antenna with basal flagellomere (and sometimes also some succeeding flagellomeres) greatly elongated, at least 3 times as long as the terminal flagellomere; verticillary hairs short as in female; proboscis not noticeably swollen apically (Fig. 11b); New World only . . . . *Deinocerites* Theobald
Antenna otherwise 22

22. Palps very short as in female; antennal flagellum with verticillary hairs short and scanty; apical flagellomere at least half as long as the basal one; proboscis distinctly swollen apically (Fig. 11d); inner claw of fore tarsus with 2-5 teeth arising from the convex surface (Fig. 17b); other claws all simple; New World tropics only . . . . *Galindomyia* Stone & Barreto[10, 23]
Without this combination of characters 23

23. Scutum covered with bright, metallic, iridescent scales; anterior pronotal lobes unusually large (see Fig. 3); palps at most two-thirds of the length of the proboscis, often much less; New World tropics and subtropics only . . . . *Haemagogus* Williston
Without this combination of characters 24

24. Postspiracular bristle or bristles present 25
Postspiracular area without bristles 29

25. Paratergite broad and bare; postnotum usually with a group of setulae (as in Fig. 3c, d); back of head, pleura and posterolateral corners of abdominal terga with conspicuous patches of broad, silvery scales; tropical Africa only . . . . *Eretmapodites* Theobald
Without this combination of characters 26

26. Decumbent scales of vertex broad, flat; postspiracular and lower mesepimeral bristles present; acrostichals and dorsocentrals absent; proboscis curved and laterally compressed (Fig. 12b); southern Asia, Japan and Melanesia only . . . . *Armigeres* Theobald (part)[11]
Without this combination of characters 27

27. Upper surface of wing with all or most scales very broad, many often asymmetrical (Fig. 13); species confined to New World or if occurring in Old World then with apical segment of palp greatly reduced (Fig. 18a) . . . . *Mansonia* Blanchard (part)[24]

Fig. 18. Male palps and proboscis, a. *Mansonia (Mansonioides) uniformis* (Theobald); b. *Ficalbia minima* Theobald; c. *Mansonia (Coquillettidia) crassipes* (Van der Wulp).

Wing seldom with scales of this type and then only in Old World species; the latter with apical and subapical segments of palps either both well developed or both greatly reduced 28

28. Palps long, slender, almost hairless, the 2 terminal joints together more than half the length of the shaft; squama bare or at most with 6 short hairs; alula with broad scales; posterior pronotum without scales; hind tarsomeres II-IV with conspicuous white basal bands; Southeast Asia only . . . . *Udaya* Thurman
Without this combination of characters . . . . *Aedes* Meigen[25]

29. Alula bare or with flat, decumbent scales (Fig. 14b, c); Old World tropics only . . *Mimomyia* Theobald[14, 15]
Alula with narrow fringe scales (Fig. 14d) 30

30. Proboscis greatly swollen on distal third or more (Fig. 18b); Old World tropics only . . . . *Ficalbia* Theobald[14]
Proboscis at most slightly swollen apically 31

31. Pulvilli present (best seen on hind legs); hind tarsal claws unusually small (as in Fig. 15b); palps various, in some cases very much shorter than proboscis . . . . *Culex* Linnaeus
Pulvilli absent; hind claws not unusually small; palps always at least as long or almost as long as proboscis 32

32. Palps longer than proboscis, the terminal segment not much shorter than the subterminal; subterminal segment and tip of shaft with numerous long hairs (Fig. 18c) . . . . *Mansonia* Blanchard (part)[26]
Palps otherwise 33

33. Palps with the last 2 segments not greatly reduced (Fig. 19b); southern Asia only . . . . *Armigeres* Theobald (part)[27]

Fig. 19. Male palps and proboscis, a. Culex *postspiraculosus* Lee; b. *Armigeres (Leicesteria) dentatus* Barraud; c. *Orthopodomyia anopheloides* (Giles).

Palps with the apical segment (and sometimes also the subapical) greatly reduced (Fig. 19c) . . . . *Orthopodomyia* Theobald[28]

III. PUPAE

The pupa of genus *Galindomyia* is undescribed.

Fig. 20. Generalized mosquito pupa. *as* Apical paddle seta, *fh* Float hair, *p* Paddle, *tr* Trumpet.

1. Segment X with a conspicuous branched hair; seta 9 on segment VIII greatly reduced; paddles without apical seta (Fig. 21a) (Subfamily Toxorhynchitinae) . . . . *Toxorhynchites* Theobald[5]

Fig. 21. Terminal segments of pupa. a. *Toxorhynchites splendens* (Wiedemann), b. *Anopheles balabacensis* Baisas, c. *Chagasia bathana* (Dyar).

Segment X without setae; seta 9-VIII and paddle various 2

2. Paddles nearly always with an accessory seta arising anterior to and in line with the apical seta (Fig. 21b, c); if not then seta 9 on segments IV-VII in the form of a short, stout, dark spine arising from the extreme posterior corner of the segment (as in Fig. 21b) and trumpets short, flared and split nearly to base (Subfamily Anophelinae)[29] 3
Paddles with accessory seta absent or, if present, arising level with and laterad of the apical seta; seta 9 usually and trumpets almost always otherwise (Subfamily Culicinae) 4

3. Seta 2-III-VII a short, stout, dark spine (Fig. 21c); New World tropics only . . . . *Chagasia* Cruz
   Seta 2 on these segments otherwise . . . . *Anopheles* Meigen
   Bironella Theobald

4. Trumpets modified for insertion into subaqueous plant tissues (Fig. 22a, b); float hair suppressed . . . . *Mansonia* Blanchard[30]

Fig. 22. Pupal trumpets. a. *Mansonia (Mansonioides) uniformis* (Theobald), b. *Mansonia (Coquillettidia) microannulata* (Theobald), c. *Hodgesia malayi* Leicester, d. *Topomyia spathulirostris* Edwards, e. *Topomyia tipuliformis* Leicester, f. *Tripteroides lorengaui* Peters, g. *Tripteroides fuscipleura* Lee.

   Trumpets otherwise or float hair well developed or both 5

5. Trumpets with a hinged tragus (Fig. 22c) . . . . . *Hodgesia* Theobald
   Trumpets otherwise 6

6. Paddles small, usually more or less pointed, without apical seta (Fig. 23) (Tribe Sabethini) 7

Fig. 23. Sabethine pupal paddles. a. *Topomyia decorabilis* Leicester, b. *Topomyia barbus* Baisas, c. *Tripteroides stonei* Belkin, d. *Limatus durhamii* Theobald, e. *Phoniomyia pallidoventer* Theobald, f. *Trichoprosopon magnum* (Theobald).

   Paddles otherwise, nearly always with apical seta[31] 14

7. Old World only 8
   New World only 10

8. Trumpets subcylindrical with inner and outer walls widely separated (Fig. 22d, e) 9
   Trumpets subconical or with inner and outer walls closely apposed or both (Fig. 22f, g) . . . . *Tripteroides* Giles[32]

9. Seta 6-VII relatively well developed, arising well cephalad of seta 9-VII (Fig. 24a) . . . . *Malaya* Leicester

Fig. 24. Segment VII of pupal abdomen. a. *Malaya genurostris* Leicester, b. *Topomyia spathulirostris* Edwards.

   Seta 6-VII usually less well developed and arising close to and laterad of seta 9-VII (Fig. 24b) . . . . *Topomyia* Leicester[33]

10. Paddles short and broad, much shorter than seta 9-VIII, with edges sometimes serrated but tips entirely bare; posterior border of segment VIII deeply excavated; trumpets narrow, cylindrical or subconical (Figs. 23d, 25a) . . . . *Limatus* Theobald

Fig. 25. Sabethine pupal trumpets. a. *Limatus durhamii* Theobald, b. *Phoniomyia edwardsi* Lane & Cerqueira, c. *Trichoprosopon soaresi* Lane & Cerqueira, d. *Sabethes soperi* Lane & Cerqueira, e. *Trichoprosopon magnum* (Theobald), f. *Wyeomyia circumcincta* Dyar & Knab.

Without this combination of characters 11

11. Trumpets slender, tubular, narrowing basally, not or only slightly expanded at apex (Fig. 25b); paddles broad with apex pointed and usually spiculate (Fig. 23e) . . . . *Phoniomyia* Theobald[34]

Trumpets broader, usually conical or beaker-shaped with basal portion expanded and inner lining well separated (Fig. 25c, d) 12

12. Either with long, delicate fringe on both borders of paddle (Fig. 26a) or with genital sac sunk in a deep embrasure (Fig. 26b) . . . . *Wyeomyia* Theobald (part)[35]

Fig. 26. Posterior segments of pupal abdomen. a. *Wyeomyia felicia* (Dyar & Nunez Tovar), b. *Wyeomyia codiocampa* Dyar & Knab, c. *Sabethes purpureus* (Theobald), d. *Trichoprosopon soaresi* Lane & Cerqueira.

Paddles without such a fringe; posterior border of segment VIII with at most a shallow excavation (Fig. 26c, d) 13

13. Seta 5-VI longer, usually much longer, than segment VII; seta 9-VI variously developed but always conspicuous (Fig. 26c) . . . . *Sabethes* Robineau-Desvoidy[36]
Wyeomyia Theobald (part)[35]

Seta 5-VI less strongly developed, often shorter than segment VII; seta 9-VI very small and inconspicuous (Fig. 26d) . . . . *Trichoprosopon* Theobald[36]
Wyeomyia Theobald (part)[35]

14. Paddles smooth on both borders with apex convex; apical paddle seta at least two-thirds as long as paddle; seta 9-VIII long, single, simple (Fig. 27a); New World only . . . . *Deinocerites* Theobald

Fig. 27. Pupal abdomen. a. *Deinocerites mcdonaldi* Belkin & Hogue, b. *Aedeomyia catasticta* Knab, c. *Opifex fuscus* Hutton.

Without this combination of characters 15

15. Paddle smooth on both borders, deeply cleft at apex; apical seta at least half as long as paddle; seta 5-IV-VI with long, frayed median branch and short lateral branches (Fig. 27b) . . . . *Aedeomyia* Theobald

Paddles and seta 5-IV-VI otherwise 16

16. Seta 9-VII very short, single, simple as on anterior segments (Fig. 27c); New Zealand only . . . . *Opifex* Hutton

Seta 9-VII more strongly developed than on anterior segments or distribution otherwise or both 17

17. Trumpets at least about 10 times as long as their breadth at half way, usually more; paddles narrow or very narrow, not or only very slightly inflated on inner aspect; fringe, usually of irregular spicules, on both borders; apical seta minute or absent (Fig. 28); Old World tropics only . . . . *Mimomyia* Theobald[14,15,37]

Fig. 28. Pupal trumpets and paddles. Genus *Mimomyia*. a. *M. perplexens* (Edwards), b. *M. hybrida* (Leicester), c. *M. chamberlaini* Ludlow, d. *M. (Etorleptiomyia) luzonensis* (Ludlow), e. *M. (Ravenalites) deguzmanae* (Mattingly).

Without this combination of characters 18

18. Paddles with long, delicate fringe on both borders; float hair arising unusually near mid line, tending to point forward in mounted specimens; seta 1-II long, stout, single or bifid; seta 5-III-VII in each case longer than the following segment (Fig. 29); Southeast Asia only . . . . *Zeugnomyia* Leicester

Fig. 29. Pupal abdomen. *Zeugnomyia lawtoni* Baisas.

Without this combination of characters 19

19. Paddles with inner half deeply excavated towards base, usually much broader than outer half; segment IX usually with a pair of small setulae; paddles fringed or toothed on both borders, usually extensively so (Fig. 30) . . . . *Uranotaenia* Lynch Arribalzaga[38]

Fig. 30. Terminal segments of pupa. Genus *Uranotaenia*. a. *U. mendiolai* Baisas, b. *U. ascidiicola* De Meijere, c. *U. modesta* Martini.

Without this combination of characters 20

20. Paddles small, with long, delicate fringe on both borders; apical paddle seta long and stout; seta 8-C much longer and stouter than 9-C (Fig. 31a, b); tropical Africa only . . . . *Eretmapodites* Theobald[39]

Fig. 31. Terminal segments and cephalothorax of pupa. a. *Eretmapodites inornatus* Newstead, b. *Eretmapodites dracaenae* Edwards, c. *Aedes (Stegomyia) ruwenzori* Haddow & Van Someren.

Without this combination of characters and distribution 21

21. Paddles with long, delicate fringe on both borders; seta 6-VI very strongly developed, longer and much stouter than 5-VI (nearly always spinose or multibranched, often subplumose); seta 9-VI a minute, colourless setula (Fig. 32a, b); southern Asia, China, Japan and Melanesia only . . . *Armigeres* Theobald[40]

Fig. 32. Terminal segments of pupa. a. *Armigeres subalbatus* (Coquillett), b. *Armigeres malayi* (Theobald), c. *Heizmannia achaetae* (Leicester).

Paddles without such a fringe or segment VI otherwise; distribution various 22

22. Paddles with long, delicate fringe on both borders; mid rib of paddle very poorly developed, barely visible, if at all, even towards base; Southeast Asia only (Fig. 33a) . . . . *Udaya* Thurman

Fig. 33. Terminal segments of pupa. a. *Udaya argyrurus* (Edwards), b. *Aedes (Stegomyia) meronephada* (Dyar & Shannon), c. *Aedes (Stegomyia) annandalei* (Theobald), d. *Heizmannia scintillans* Ludlow.

Paddles various, if with long fringe then mid rib always strongly developed, conspicuous (Fig. 33b-d) 23

23. Paddles with long, delicate fringe on both borders, oval, usually more or less pointed, never indented at tip; seta 9-VI minute, colourless (Fig. 33d) or if not then either seta 5-II long, stout, dark

(Fig. 34a) or seta 5 on all segments very short (Fig. 34b); southern Asia only. . . . . *Heizmannia* Ludlow[41]

Fig. 34. Pupal abdomen. Genus *Heizmannia*. a. *H. complex* (Theobald), b. *H. aureochaeta* (Leicester).

Without this combination of characters 24

Fig. 35. Terminal segments of pupa. a. *Aedes (Lorrainea) fumidus* (Edwards), b. *Ae. (Diceromyia) franciscoi* Mattingly, c. *Ae. (Diceromyia) periskelatus* (Giles).

Fig. 36. Pupal abdomen. *Aedes* subgenus *Stegomyia*. a. *Ae. albopictus* (Skuse), b. *Ae. desmotes* (Giles).

24. Trumpets at least 7 times as long as their breadth at half way, the pinna occupying at least half the length, meatus entirely tracheoid or almost so; seta 9-VIII very feebly developed; paddle edge strongly serrated on outer half, inner half smooth (Fig. 37); Old World tropics only. . . . . *Ficalbia* Theobald[14]

Fig. 37. Pupal trumpet and terminal segments. Genus *Ficalbia*. a. *F. circumtestacea* (Theobald), b. *F. malfeyti* (Newstead).

Without this combination of characters 25

25. Paddles more or less rectangular with thickened basal portion of outer edge sometimes spiculate but whole border otherwise smooth, hyaline; accessory paddle seta absent; apical paddle seta very short; seta 9-VII-VIII long, stout, plumose, on VIII about half the length of the paddle or more (Fig. 38) . . . . *Orthopodomyia* Theobald[42]

Fig. 38. Pupal cephalothorax and terminal segments. Genus *Orthopodomyia*. a. *O. flavicosta* Barraud, b. *O. wilsoni* Macdonald.

Without this combination of characters 26

26. Trumpets with tubular portion occupying most of the length and with rudimentary basal tracheation at most; seta 9-VIII arising from the posterolateral corner of the segment, not, or only very slightly, displaced anteriorly; either with posterior corner of abdominal segment IV toothed or with prominent ventral lobes on posterior border of segment VIII, partly covering the bases of the paddles, or with accessory paddle seta present (Fig. 39); New World only. *Psorophora* Robineau-Desvoidy[43]

Fig. 39. Pupa. Genus *Psorophora*. a. Cephalothorax and abdomen, *Ps. ciliata* (Fabricius), b. Segment IV of abdomen, *Ps. ferox* (Humboldt), c. Segments I-II, *Ps. infinis* (Dyar & Knab)[43]

Without this combination of characters 27

27. Seta 8-C arising anterior or at most slightly posterior to base of trumpet, very much anterior to 9-C; trumpet nearly always with rudimentary basal tracheation at most; seta 9-VIII rarely arising cephalad of the posterior border of the segment (Fig. 40) 28

Fig. 40. Pupal cephalothorax and abdomen. a. *Haemagogus spegazzinii* Brethes, b. *Haemagogus capricornii* Lutz, c. *Aedes aegypti* (Linnaeus).

Seta 8-C arising level with or posterior to the base of the trumpet, more nearly level with 9-C; trumpets frequently with extensive subbasal tracheation; position of seta 9-VIII various (Fig. 41) 29

Fig. 41. Pupal cephalothorax and abdomen. a. *Culex pipiens* Linnaeus, b. *C. antillummagnorum* Dyar, c. *Culiseta longiareolata* (Macquart).

28. Setae 8-C and 9-C poorly developed; setae 5-II and 5-III very feebly developed, not or barely reaching onto the following segment; either with seta 5-VII as long as or longer than the following segment or with mid rib of paddle deeply pigmented and seta 5-IV-VI shorter than the following segment; seta 9-III-VI minute; seta 9-VIII with 4 or more branches, about half the length of the paddle or more (Fig. 40a, b); New World tropics and subtropics only . . *Haemagogus* Williston[44]

Without this combination of characters or distribution otherwise . . . . *Aedes* Meigen[45]

29. Trumpets with well developed subbasal tracheation or seta 9-VIII arising well cephalad of the posterior border of the segment, usually both (Fig. 41a, b, 42a-c). . . . . *Culex* Linnaeus[45]

Fig. 42. Pupal cephalothorax. a. *Culex davisi* Kumm, b. *Culex bamborum* Rozeboom & Komp, c. *Culex pseudomelanoconia* Theobald, d. *Aedes aurantius* (Theobald), e. *Aedes longirostris* (Leicester), f. *Aedes gilli* Barraud.

Trumpets with rudimentary basal tracheation at most; seta 9-VIII always arising from the posterior border of the segment (Fig. 41c) . . . . *Culiseta* Felt[4,46]

IV. FOURTH STAGE LARVAE

The larva of genus *Galindomyia* is undescribed.

1. Respiratory siphon absent; seta 1 usually palmate on most abdominal segments (Fig. 43) (Subfamily Anophelinae) 2

Fig. 43. Terminal segments of anopheline larvae. a. *Chagasia bathana* (Dyar), b. *Anopheles balabacensis* Baisas.

Siphon present; seta 1 never palmate 4

2. Anterior flap of spiracular apparatus produced into a long, spinelike process, ventral valves with fringe of fine hairs; palmate hairs characteristically shaped (Fig. 43a); New World tropics only *Chagasia* Cruz

Spiracular apparatus and palmate hairs otherwise 3

3. Inner clypeal setae close together; seta 1 of mesothorax palmate (Fig. 44); northern Australia, Melanesia and Moluccas only . . . . *Bironella* Theobald

Fig. 44. Larval head and thorax. *Bironella hollandi* Taylor. *icl* Inner clypeal setae.

Without this combination of characters and distribution . . . . *Anopheles* Meigen

4. Mouthbrushes with about 10 flattened, nonpectinate blades; antenna with setae 2-A and 3-A arising basad of seta 1-A; comb and pecten absent (Fig. 45) (Subfamily Toxorhynchitinae) . . . . *Toxorhynchites* Theobald[5]

Fig. 45. Larval head and terminal segments. *Toxorhynchites splendens* (Wiedemann).

Mouthbrushes with numerous hairs; antenna with setae 2-A and 3-A distad of 1-A; comb almost always present; pecten present or absent (Subfamily Culicinae) 5

5. Ventral brush with at most 2 pairs of setae, usually only 1, (Fig. 46); New World only[47] 6

Fig. 46. Terminal segments of New World sabethine larvae. a. *Sabethes purpureus* (Theobald), b. *Phoniomyia fuscipes* (Edwards). *vbr* Ventral brush, *lcs* Lower caudal seta.

Ventral brush with 3 pairs of setae or more or species confined to Old World 10

6. Setae of ventral brush as long, or almost as long, as lower caudal setae; siphon relatively slender, at least about 3.5 times as long as saddle; comb teeth in a single row or with at most 3 or 4 detached (Fig. 46a) . . . . *Sabethes* Robineau-Desvoidy
Wyeomyia Theobald (part)[48]

Setae of ventral brush much shorter than lower caudal setae or siphon short and stout or comb teeth in at least 2 complete rows or with any combination of these 7

7. Siphon long, slender, strongly tapering, about 5 times as long as its breadth at base or more, with numerous long, unbranched setae dorsally and ventrally; comb teeth in 2 or more rows (Fig. 46b) . . . *Phoniomyia* Theobald
Wyeomyia Theobald (part)[49]

Siphon otherwise or comb teeth in a single, regular row (sometimes arising from a sclerotized plate) or both 8

8. Siphon short, stout, at most about 3 times as long as its breadth at base with several branched setae dorsally and ventrally; head setae 4-C, 5-C and 6-C single; maxillary "horns" not developed; comb with about 4-7 teeth in a single row, not arising from a sclerotized plate (Fig. 47) . . . . *Limatus* Theobald

Fig. 47. Larval head and terminal segments. *Limatus durhamii* Theobald. *mx* Maxilla.

Without this combination of characters; maxillary "horns" present in some species (Fig. 48) 9

Fig. 48. Larval head and terminal segments. *Trichoprosopon frontosum* (Theobald). *mx* Maxilla.

9. Mandible greatly enlarged (Fig. 49a) or maxilla with a large "horn"(Fig. 48); siphon with a dense midventral row of setae extending for almost the whole length (Fig. 48) or setae of ventral brush at least 3 times as long as saddle . . . . *Trichoprosopon* Theobald

Fig. 49. Larval head and terminal segments. a. *Trichoprosopon digitatum* (Rondani), b. *Wyeomyia confusa* (Lutz). *md* Mandible, *mx* Maxilla.

Mandibles never thus; maxilla seldom with conspicuous "horn", if so then ventral brush or siphon otherwise . . . . . . *Wyeomyia* Theobald (part)[50]

10. Ventral brush with a single pair of setae (1 or 2 small, supplementary hairs present in occasional individuals); antenna short, without articulated apical segment; siphon with 2 or (usually) more subdorsal setae as well as various ventral or subventral setae (Fig. 50). 11

Fig. 50. Larval head, prothorax and terminal segments. a. *Malaya genurostris* Leicester, b. *Topomyia gracilis* Leicester.

Without this combination of characters[51] 13

11. Prothoracic setae 5 and 6 large fan-shaped tufts arising from a common tubercle; comb usually a patch of teeth in 2 or more rows (Fig. 50); seta 6 of mesothorax and seta 7 of metathorax never stout spines; tropical Africa, southern Asia and Melanesia only 12

Fig. 51. Larval head and terminal segments. a. *Mimomyia (Ravenalites) deguzmanae* (Mattingly), b. *Culex (Acallyntrum) belkini* Stone & Penn.

Prothoracic setae otherwise; seta 6 of mesothorax and/or seta 7 of metathorax often a stout spine; comb teeth in a single row, sometimes arising from a sclerotized plate, occasionally absent or reduced to a single tooth (Fig. 52), or distribution otherwise . . . . *Tripteroides* Giles[52, 53]

Fig. 52. Head, thorax and terminal segments of larva. Genus *Tripteroides*. a. *T. powelli* (Ludlow), b. *T. stonei* Belkin.

12. Either abdominal segments IV-VI (at least) with 1 or more pairs of stellate setae with numerous short, stiff branches (Fig. 50b, 53a) or maxillae with conspicuous "horns" (Fig. 53b) or siphon at least 6 times as long as saddle (Fig. 53c); southern and eastern Asia and Melanesia only . . . . *Topomyia* Leicester[53]

Fig. 53. Genus *Topomyia*. a. Segment V of larval abdomen. *T. tenuis* Edwards, b. Larval head., *T. decorabilis* Leicester, c. Terminal segments of larva. *T. spathulirostris* Edwards. *mx* Maxilla.

Setae of this kind never present; maxillae never with "horns"; siphon at most about 4 times as long as saddle (Fig. 50a); Old World tropics from Africa to eastern Asia and Melanesia . . . . *Malaya* Leicester

13. Siphon modified for piercing plant tissues, with sclerotized saw-toothed process at tip (Fig. 54a) . . . . *Mansonia* Blanchard

Fig. 54. Terminal segments of larva. a. *Mansonia uniformis* (Theobald), b. *Mimomyia hybrida* (Leicester).

Siphon not so modified or, if so, without any saw-toothed process (Fig. 54b) 54 14

14. Antenna broad, flattened; some thoracic setae enormously long, others stellate; tip of siphon with paired hooks and branched setae (Fig. 55) . . . . *Aedeomyia* Theobald

Fig. 55. Larval head, thorax and terminal segments. *Aedeomyia catasticta* Knab.

Antenna, thoracic setae and siphon otherwise 15

15. Siphon with a single pair of subventral setae; metathoracic setae 9-12 very short, unbranched (Fig. 56); New Zealand only . . . . *Opifex* Hutton

Fig. 56. Larval thorax and terminal segments. *Opifex fuscus* Hutton.

Without this combination of characters or distribution otherwise 16

16. Siphon with a single pair of subventral setae arising at not more than one-fifth of the distance from base to apex; comb a single row of at most 20 teeth; siphon less than twice as long as saddle (Fig. 57); Old World tropics only 17

Fig. 57. Larval head and terminal segments. a. *Hodgesia malayi* Leicester, b. *Ficalbia minima* (Theobald).

Without this combination of characters or distribution otherwise 55 18

17. Head seta 5 arising almost directly behind 6 which is single; head seta 4 nearly as long as 5; pecten with at least 3 teeth, usually more (Fig. 57a) . . . . *Hodgesia* Theobald

Head setae otherwise; pecten with at most 2 teeth (Fig. 57b) . . . . *Ficalbia* Theobald[56]

18. Distal portion of antenna freely articulated (Fig. 58); siphon with a single pair of subventral setae; pecten with at most 4 teeth on either side, often fewer; ventral brush with 2-4 pairs of setae, 1 or 2 supernumerary setae occasionally present in addition; Old World tropics only . . . . *Mimomyia* Theobald[14,15,54]

Fig. 58. Larval head. Genus *Mimomyia*. a. *M. (Mimomyia) chamberlaini* Ludlow, b. *M. (M.) plumosa* (Theobald), c. *M. (Ravenalites) deguzmanae* (Mattingly).

Antenna never thus; siphon often otherwise; ventral brush with at least 3 pairs of setae, often with 5 or more pairs 19

19. Pecten absent; siphon very short and broad with a single pair of subventral setae arising beyond half way; antennal seta minute (Fig. 59a); southern Asia, Japan and Melanesia only . . . . *Armigeres* Theobald[57]

Fig. 59. Larval head and terminal segments. a. *Armigeres subalbatus* (Coquillett), b. *Orthopodomyia wilsoni* Macdonald.

Without this combination of characters and distribution 20

20. Pecten absent; antennal seta arising on basal half, with 4 or more branches; head setae 5 and 6 long and branched; siphon at least about 2.5 times as long as its breadth at base, often much longer, with a single pair of subventral setae; ventral brush with 6 pairs of setae or more (Fig. 59b) . . . . *Orthopodomyia* Theobald[57]

Without this combination of characters 21

21. Head with a pair of conspicuous lateral pouches; siphon with a pair of large subventral setae and 2 pairs of smaller setae distal to this, 1 subdorsal, the other subventral; saddle poorly developed; a small accessory sclerotized plate usually present basad of the ventral brush (Fig. 60a); New World only . . . . *Deinocerites* Theobald

Fig. 60. Larval head and terminal segments. a. *Deinocerites cancer* Theobald, b. *Culiseta longiareolata* (Macquart), c. *Culiseta littleri* (Taylor).

Without this combination of characters 22

22. Siphon with a single pair of subventral setae arising at not less than a quarter of the distance from base to apex, usually more; (a pair of minute subdorsal setae also usually present near tip) (Figs. 62-65)[58] 23

Siphon with subventral setae more numerous or (in 1 or 2 neotropical species) entirely absent or if with a single pair of such setae then these arising at about one-fifth of the distance from base to apex or less (Figs. 60b, 69a) 30

23. Maxillary suture absent or incomplete, not reaching posterior tentorial pit (Fig. 61a); head seta 5 or 6 or both often flattened, barbed, spinelike; comb often arising from a large sclerotized plate (Fig. 62a) . . . . *Uranotaenia* Lynch Arribalzaga[57,59]

Fig. 61. Larval head in ventral view. a. *Uranotaenia sapphirina* (Osten-Sacken), b. *Aedes aegypti* (Linnaeus). *m* Mentum, *ms* Maxillary suture, *ptp* Posterior tentorial pit.

Fig. 62. Larval head and terminal segments. a. *Uranotaenia sapphirina*, b. *Aedes (Stegomyia) annandalei* (Theobald).

Maxillary suture well developed, extending from the level of the mentum to the posterior tentorial pit (Fig. 61b); head setae 5 and 6 sometimes single and barbed but never spinelike; comb plate, if present, smaller (Fig. 62b) 24

24. Antennal seta and head setae 4-7 small, delicate, inconspicuous; comb teeth never in a regular row; siphon at most about 3.5 times as long as its breadth at base, usually much shorter; pecten with at most 7 teeth, usually fewer (sometimes absent); ventral brush with 4 (rarely 5) pairs of stout, strongly plumose setae, some of them usually single (Fig. 63a); Ethiopian Region only . . . . *Eretmapodites* Theobald[60]

Fig. 63. Larval head and terminal segments. a. *Eretmapodites chrysogaster* Graham, b. *Aedes aegypti* (Linnaeus), c. Segment V of larval abdomen, *E. chrysogaster*.

Without this combination of characters and distribution 25

25. Comb with at most 10 teeth, in a single row; head seta 5 single, 4 and 6 shorter than 5 with 2 or more delicate branches, 7 single and much longer than any of these (Fig. 64); Southeast Asia only . . . . *Udaya* Thurman

Fig. 64. Larval head and terminal segments. Genus *Udaya*. a. *U. argyrurus* (Edwards), b. *U. lucaris* Macdonald & Mattingly.

Comb various; head setae otherwise; distribution various 26

26. Comb teeth in a single row; saddle incomplete with strongly developed spines along the distal edge; head seta 7 slender, delicate, single or bifid, 5 and 6 long, single, somewhat stouter than 7 but not conspicuously thickened (Fig. 65a); Southeast Asia only . . . . *Zeugnomyia* Leicester[61]

Fig. 65. Larval head and terminal segments. a. *Zeugnomyia aguilari* Baisas & Feliciano, b. *Heizmannia scintillans* Ludlow.

Without this combination of characters and distribution 27

27. Head seta 4 large and conspicuous, 6 markedly anterior to 5 and 7, 7 with at least 5 branches, usually more; stellate setae absent; thoracic integument devoid of spicules; comb teeth never fused at base or arising from a sclerotized plate; pecten teeth with secondary denticles, if any, confined to base; saddle incomplete (Fig. 65b); southern and eastern Asia only . . . . *Heizmannia* Ludlow[62]

Without this combination of characters and distribution 28

Fig. 66. a. Larval head. *Aedes (Christophersiomyia) gombakensis* Mattingly, b. Larval head and thorax. *Aedes (Finlaya) poecilus* (Theobald).

28. Comb teeth in a single, regular row; anal segment completely ringed by saddle, the latter pierced in the mid line by the proximal setae of the ventral brush which form a midventral row extending almost to the base of the anal segment (Fig. 67a, b); New World only . . . . *Psorophora* Robineau-Desvoidy[63]

Fig. 67. Larval head and terminal segments. a. *Psorophora howardii* Coquillett, b. *Psorophora signipennis* (Coquillett), c. *Aedes diantaeus* Howard, Dyar & Knab, d. *Aedes atlanticus* Dyar & Knab.

Without this combination of characters and distribution 29

29. Antenna short, smooth or almost so; antennal seta very small, single or bifid, rarely trifid; head setae 5 and 6 slender, single or bifid, 6 markedly anterior to 7; saddle incomplete; ventral brush arising from a sclerotized boss (Fig. 68a); New World tropics and subtropics only . . . . *Haemagogus* Williston[64]
Aedes Meigen (part)

Fig. 68. Larval head and terminal segments. a. *Haemagogus capricornii* Lutz, b. *Aedes serratus* (Theobald).

Without this combination of characters and distribution . . . . *Aedes* Meigen (part)[64]

30. Siphon with a single pair of subventral setae arising near base (with or without a midventral row of setae beyond this) (Figs. 60b, 69a) . . . . *Culiseta* Felt[55,58]

Fig. 69. Terminal segments of larva. a. *Culiseta melanura* (Coquillett), b. *Culex pipiens* Linnaeus, c. *Culex modestus* Ficalbi.

Siphon with subventral setae usually well removed from mid line (Fig. 69b), occasionally forming a midventral row (Fig. 69c) but never with a separate pair arising near base . . . . *Culex* Linnaeus[55]

NOTES ON THE KEYS

1. Outside the genus *Bironella* this condition is found only in certain members of the *Anopheles leucosphyrus* Dönitz complex.

2. Genera *Malaya*, *Hodgesia*, *Uranotaenia*, *Zeugnomyia* and, in part, *Topomyia* are characterized by the fact that vein 1A turns down abruptly to reach the wing margin before or at most very slightly beyond the base of the fork of vein Cu (Fig. 6a). This is a very distinctive character shared only by *Aedes* subgenus *Cancraedes* and the males of a few *Culex*. In some *Limatus* spp. there is a tendency for the tip of vein 1A to turn down abruptly but this seems always to take place well beyond the base of the fork of vein Cu. In *Zeugnomyia* the tip of vein 1A turns down abruptly but sometimes reaches the wing margin slightly beyond the base of the fork of vein Cu. Doubtful specimens are easily recognized by the vertical silvery stripe extending from the prealar area down to the mid coxa (Fig. 7).

3. *Topomyia* and some species of the closely related genus *Malaya* (formerly *Harpagomyia)* are very similarly ornamented, having a conspicuous median longitudinal white or silvery stripe on the scutum (occasionally brownish in *Topomyia*). They can, however, always be distinguished with ease by the proboscis. This is strongly swollen towards the tip in some *Topomyia* but never shows the extensive modifications, associated with feeding on the regurgitations of ants, which are found in *Malaya*.

4. Formerly called *Theobaldia* by workers in the Old World.

5. *Tripteroides*, *Malaya* and *Topomyia*, together with the New World genera in couplets 14-17, form the tribe Sabethini of the subfamily Culicinae. The other subfamilies of Culicidae are the Anophelinae *(Anopheles*, *Bironella*, *Chagasia)* and the Toxorhynchitinae with the single genus *Toxorhynchites* *(Megarhinus* of earlier authors).

6. It has been proposed to place the New Zealand species *T. argyropus* (Walker) in a monotypic genus *Maorigoeldia* but this is retained here as a subgenus of *Tripteroides*.

7. One species of *Phoniomyia* has the tarsi entirely dark in a proportion of individuals. The very short antenna, of the order of a third of the length of the proboscis, distinguishes it from other New World sabethines with comparable proboscis. Some *Trichoprosopon* or a few *Wyeomyia* spp. with unusually long proboscis might be confused but these can be recognized by the entirely dark scutellum or tarsi or both. A few *Trichoprosopon* spp. with white tarsal markings have a peacock blue, rather than silvery, scale patch on the mid lobe of the scutellum.

8. A few *Trichoprosopon* spp. have scutal scales with dull, bluish lustre but they are never brightly iridescent. A few *Wyeomyia* spp. with bright metallic scutal scaling might run down here but these are distinguished by the presence of prealar bristles.

9. Two species lacking postnotal bristles have been placed in a separate genus, *Mattinglyia*. I prefer to treat this as a subgenus of *Heizmannia* and am describing an annectant species elsewhere.

10. Known only from a single species with undescribed early stages and uncertain affinities.

11. *Armigeres* differs markedly from *Mansonia* in the broad scaled vertex and from *Udaya* in the heavily scaled pleuron. *Aedes* is distinguished, except from *Armigeres* s. str., by the presence of postspiracular bristles. *Aedes* subgenus *Alanstonea* resembles *Armigeres* s. str. closely in general facies but differs in having no lower mesepimeral bristle. All other *Aedes* lack the curved proboscis. Another character distinguishing many *Aedes* is the presence of acrostichal or dorsocentral bristles.

12. Some authors recognize *Mansonia* and *Coquillettidia* as distinct genera, each with two subgenera. I prefer to include all four subgenera in the genus *Mansonia*. Apart from a single species, all the subgenera, except *Coquillettidia*, run to the present couplet. *Coquillettidia* and one species of subgenus *Rhynchotaenia* run to couplet 32.

13. *Culex postspiraculosus* Lee, from Australia, would also run down here. It is the only known *Culex* in which postspiracular bristles occur otherwise than as an occasional aberration. It is recognizable as a *Culex* by the well developed pulvilli. (See Fig. 15a). One species of *Aedes*, formerly placed in a separate genus, *Ayurakitia*, lacks postspiracular bristles but runs down correctly, via couplet 25, to the present couplet since it has toothed fore and mid tarsal claws and palps less than a quarter of the length of the proboscis. (See also note 27)

14. The genus *Ficalbia* is currently held to include four subgenera. In my view, however, the nominotypical subgenus differs too widely from the others for this treatment to be acceptable. I prefer, therefore, to treat *Ficalbia* s. str. as a separate genus, referring the other three subgenera to genus *Mimomyia*. Diagnostic characters are given in the keys.

15. One species extends beyond the tropics in the extreme eastern part of its range, as far north as Okinawa. Two others extend some distance south of the tropics in Queensland.

16. Subgenus *Coquillettidia* and one species of subgenus *Rhynchotaenia* lacking postspiracular bristles. (See note 12). One species of *Armigeres*, with simple claws, would also run down here but this can be immediately recognized by the flat scaled vertex, palps more than half as long as proboscis and the curved proboscis (as in Fig. 12).

17. Based on external characters only.

18. Males of *Aedes* subgenus *Cancraedes*, from southern Asia, would also run down here. They differ from *Uranotaenia* in having postspiracular bristles and 2 or more lower mesepimerals. (One or none in *Uranotaenia*).

19. A few species of *Wyeomyia*, with unusually long proboscis, might run down here but all of these have either the scutellum or the tarsi entirely dark scaled or both. One species of *Phoniomyia* has the tarsi entirely dark in a porportion of individuals but this is recognizable from any *Wyeomyia* with a comparable proboscis by the very short antenna (not more than about one third of the length of the proboscis).

20. One or two species of *Wyeomyia* with bright metallic scutal scaling might run down here but these can be recognized by the presence of prealar bristles.

21. The very long male palps will separate most *Trichoprosopon* spp. from other New World sabethines. Some of the few *Trichoprosopon* spp. with

short male palps have narrow scutal scales which are completely diagnostic. The others have the two terminal antennal flagellomeres greatly elongated, together about 10 times as long as the antepenultimate flagellomere or more (Fig. 16d). No *Trichoprosopon* spp. have bright, metallic scutal scaling though a few have scutal scales with dull bluish reflection.

22. See note 9. Males of subgenus *Mattinglyia* differ from those of the nominotypical subgenus in having quite strongly plumose antennae and in lacking postnotal setae.

23. Some *Haemagogus* have short male palps and reduced flagellar setae but their antenna in no way resembles that of *Galindomyia*. It is subplumose with all flagellomeres, except the last, very short.

24. All except subgenus *Coquillettidia* and one species of subgenus *Rhynchotaenia*. (See notes 16 and 27).

25. The Australian *Culex postspiraculosus* would run down here. (See note 13). It can be recognized by the long, upturned, tapering palps (Fig. 19a).

26. Subgenus *Coquillettidia* only. (See note 24).

27. Subgenus *Leicesteria* only. Individuals of *Mansonia (Rhynchotaenia) arribalzagai* Theobald lacking postspiracular bristles would also run down here but this species and subgenus are found only in the New World tropics. *Aedes (Kompia) purpureipes* Aitken, which is almost unique among *Aedes* in lacking postspiracular bristles, would also run down here but this species is found only in the United States and Mexico.

28. *Aedes* subgenus *Ayurakitia* would run down here. (See note 13). It includes only one species and is known only from Thailand. It differs from *Orthopodomyia* in many details of ornamentation, among them the restriction of the pleural scaling to four small silvery spots.

29. In some *Bironella* spp. the accessory paddle seta is absent or arises level with the apical paddle seta. These can at once be recognized as anopheline by the character of seta 9 and the trumpets. Among non-anopheline genera only *Aedeomyia* (Fig. 27b) has seta 9 approximately as in *Anopheles*. One species of *Uranotaenia* has a trumpet of anopheline type, but this is recognizable by the other characters given.

30. Some *Mimomyia* have a rather similar trumpet but, apart from the African *M. perplexens*, these have the float hair well developed. *M. perplexens* has the trumpet modified in quite a different way from any *Mansonia* sp. (Fig. 28a). Pupae of subgenus *Coquillettidia*, and apparently also *Rhynchotaenia*, have the tips of the trumpets equipped with backwardly directed barbs which prevent them being withdrawn. The tips break off short when the pupa rises to the surface at the time of emergence. They are consequently seldom seen in cast skins.

31. Absent only in some *Mimomyia* with a highly characteristic type of paddle.

32. Complete separation of *Tripteroides* pupae from those of other Old World sabethines is not at present possible but almost all can be recognized by the combination of characters given in the key.

33. All but two of the known *Topomyia* pupae have seta 6-VII as in Fig. 24b. Both the others have it as in *Malaya* but differ from that genus in having all or most of the paddle surface spiculate (Fig. 23a).

34. *Trichoprosopon magnum* (Fig. 25e) has longer trumpets than are usual in the genus but differs from all known *Phoniomyia* in having them strongly expanded at the tip and from known *Limatus* spp. in the large paddles and relatively shallow excavation of the posterior border of segment VIII (Fig. 23f). *Wyeomyia circumcincta* would key here with *Phoniomyia* but has the trumpets much longer than any known in that genus (Fig. 25f).

35. Pupae of *Wyeomyia* cannot be entirely separated from those of *Sabethes* or *Trichoprosopon* on currently available material and descriptions.

36. Some *Sabethes* spp. have seta 9-VI more strongly developed, others less strongly developed, than in the figure but it is always more conspicuous than in any known *Trichoprosopon*. All those *Sabethes* spp. with feebly developed seta 9-VI which are known to me have seta 5-VI more strongly developed than in any known *Trichoprosopon* except perhaps *Tr. magnum* with its distinctive trumpet (Fig. 25e and see note 34).

37. Subgenera *Etorleptiomyia* and *Ravenalites* of genus *Mimomyia* have highly distinctive pupae unlikely to be confused with any others (Fig. 28d, e). The resemblance of some pupae of subgenus *Mimomyia* to those of *Mansonia* has already been mentioned (note 30). A few *Uranotaenia* resemble *Mimomyia* superficially in the shape of the paddle and the long trumpets but can be recognized by the excavation of the basal part of the inner half of the paddle and the presence of paired setulae on abdominal segment IX (Fig. 30a). The African *M. splendens* Theobald is unique in having a fringe of long, hairlike spicules on both borders of the paddle but it should run down correctly.

38. The characteristic paddle shape is usually conspicuous, least so in one or two aberrant species resembling the Sabethini but differing from these in the presence of an apical paddle seta (Fig. 30b). A few *Aedes (Lorrainea)* and *Armigeres* s. str. have a similar type of paddle but with a delicate fringe on both borders which is very rare in *Uranotaenia* (Figs. 32a, b, 35a). The few *Uranotaenia* with such a fringe can be recognized from both the above genera by the reduction of seta 9-VIII and the paddle seta (Fig. 30c). One or two *Haemagogus* spp. have a somewhat similar paddle but are easily recognized by the combination of characters given in couplet 27. Paired setulae are present on abdominal segment IX in most *Uranotaenia* (Fig. 30a) but absent in a few atypical ones (Fig. 30b, c).

39. The only species which might be confused are a few members of the *Aedes (Stegomyia) africanus* group (Fig. 31c) but these have the paddle fringe and apical seta less strongly developed and differ in various other characters among them the cephalothoracic setae as indicated in the key.

40. *Armigeres malayi* (Fig. 32b) has seta 6-VI less strongly developed than in other species but still much better developed than 5-VI. One species of *Heizmannia* (Fig. 32c) would run here but this differs from *Arm. malayi* in the much more strongly developed seta 9-VIII and from other *Armigeres* in having seta 6-VI much less strongly developed.

41. *Aedes (Lorrainea)* spp. have a similar paddle fringe but are recognizable by the characteristic paddle shape (Fig. 35a and see note 38). *Ae.*

(Diceromyia) spp. differ in the indented tip of the paddle (Fig. 35b) except for *Ae. periskelatus* which has the apical paddle seta longer and stouter than in *Heizmannia* (Fig. 35c) as do some *Stegomyia* (Fig. 36a). A few other *Stegomyia* present difficulties but can be recognized by having seta 5 on most segments intermediate in type (Fig. 36b), less reduced than in *H. aureochaeta* (Fig. 34b), more so than in other *Heizmannia* (Figs. 33d, 34a).

42. Some *Aedes*, particularly *Ae. (Finlaya)* spp., have a similar paddle but differ either in the much longer apical paddle seta or in the reduction of seta 9-VII-VIII or both. The relative position of setae 8-C and 9-C also furnishes an absolute distinction from *Aedes*. (See Fig. 40c).

43. Subgenera *Psorophora* and *Janthinosoma* are distinguished from other genera by the lobed posterior border of segment VIII and/or the toothed posterolateral corner of segment IV. Most species of subgenus *Grabhamia* are distinguished, except from *Culex* and one species of *Culiseta* by the presence of an accessory paddle seta. *Culex* are readily distinguishable by the tracheated trumpet or anterior displacement of seta 9-VIII, usually both. The only New World *Culiseta* with an accessory paddle seta, *C. melanura*, is distinguished by having the trumpet cleft nearly to base, i.e. with very short tubular portion. *Aedes atropalpus* is said sometimes to have an accessory paddle seta but this species can be recognized by the short, broad paddle, almost as broad as, or broader than, long with apex flattened and more or less indented. In *Grabhamia* the paddle is distinctly longer than broad or has a rounded or pointed apex, usually both. One species of *Grabhamia* from the Caribbean area lacks the accessory paddle seta and would run to *Aedes* in couplet 28. It can be recognized by having seta 2-II well inside 3-II and seta 5-II almost directly anterior to 3-II (Fig. 39c).

44. The only *Haemagogus* sp. known to me which might not run down here is *H. chalcospilans*. It is recognizable from any known *Aedes* or *Psorophora* by the combination of very short setae 5-II and 5-III, setae 5-IV and 5-V only a little longer than the following segments, seta 9-III-VI minute, seta 9-VII with several branches, 9-VIII about half the length of the paddle, paddle with apex pointed and short, branched apical paddle seta. A number of *Aedes* otherwise resembling *Haemagogus* have seta 5 on one or more abdominal segments as long as the two following segments together. In *Haemagogus* seta 5 is never more than a little longer than the following segment. *Aedes aegypti* is at once distinguished by the well developed seta 9-III-VI (Fig. 40c).

45. The relative position of setae 8-C and 9-C appears to be almost completely diagnostic as between *Aedes* and *Culex*. In the former, however, seta 8-C occasionally arises somewhat posterior to the trumpet (Fig. 40c) while in the latter it arises further forward in some species than in others. In comparing pupal skins, therefore, the specimens must be carefully oriented. A few small New World *Culex* apparently have these setae as in *Aedes* but these have trumpets with subbasal tracheation of a kind unknown in the New World aedine genera (Fig. 41b). In the great majority of *Culex* seta 9-VIII arises well cephalad of the posterior border of the segment (Fig. 41a). The few species known to me in which this is not so have slender trumpets with extensive tracheation of a kind almost unknown in *Aedes* (Fig. 42a-c). They are all small or very small species. The few *Aedes* with comparable tracheation are all Old World species and are either large or very large species or have seta 8-C much further forward than in any Old World *Culex* (Fig. 42d, e). In contrast to this seta 9-III

rarely arises cephalad of the posterior border of the segment in *Aedes*. All the species in which it is known to do so have trumpets with poorly developed basal tracheation and seta 8-C arising well forward (Fig. 42f). (See also note 43).

46. The relative position of setae 8-C and 9-C appears to be absolutely diagnostic as between *Aedes* and *Culiseta* (Figs. 40c, 41c). In the latter seta 8-C always arises far back. Additional partial characters are the abnormally long seta 1-IV-VI in most *Culiseta* (but not the tropical African species) and the presence of an accessory paddle seta in about half the known species. These characters should not, however, be needed for diagnosis.

47. Two species of *Sabethes* have a pair of small, supernumerary setae in addition to the single pair of well developed setae by which the ventral brush is represented in all other known sabethines.

48. Most *Wyeomyia* spp. have the setae of the ventral brush short (often stellate). In some they are longer, though still much shorter than the lower caudal seta. All but about 3 of the remaining species can be recognized by the arrangement of the comb teeth as indicated in the key. Some *Sabethes* spp. have a pair of dorsal, chitinous hooks on abdominal segment VII. These are unknown in any other New World genus.

49. A few *Trichoprosopon* spp. have the siphon moderately long, slender, tapering with several short subdorsal setae. In these, however, the ventral setae form a long row of branched tufts quite unlike anything found in *Phoniomyia*. Two or three *Wyeomyia* spp. would run down here and are best separated at the species level.

50. None of the few species of *Wyeomyia* with the siphon as in Fig. 48 has a conspicuous maxillary horn. Two species which might run down to the first half of the present couplet are *W. confusa* (Fig. 49b) and *W. occulta*. The former, however, has an enormously elongated maxilla, quite unlike that of any other species in either genus, while the latter differs from any known *Trichoprosopon* lacking a mid-ventral row of setae on the siphon in having a comb of numerous scales in a patch three rows deep. An additional character serving to distinguish most, though not quite all, species of *Trichoprosopon* with the siphon otherwise than in Fig. 48 is the very small number of comb teeth (5 or less; not less than 10 in *Wyeomyia* spp. with maxillary horn).

51. Two African *Culex* spp. lack the ventral brush entirely. In *Mimomyia* subgenus *Ravenalites* it comprises two pairs of setae only. Some members of this subgenus have a superficial resemblance to *Tripteroides* but they can be recognized at once by the articulated terminal joint of the antenna and the presence of only one pair of subventral setae on the siphon (Fig. 51a). In *Culex (Acallyntrum)* spp. from Melanesia the ventral brush is represented by a single pair of setae. Larvae of these species differ from those of the sabethine genera in lacking dorsal or subdorsal setae on the siphon (Fig. 51b). In addition the larvae of the sabethine genera almost always have the antenna and antennal seta much reduced while in many the thorax and abdomen are covered with large stellate setae (Fig. 52a), a condition not met with in *Acallyntrum*.

52. Some *Topomyia* have the comb reduced to a single row or almost so. These, however, can at once be separated from *Tripteroides*, as can all other *Topomyia* and *Malaya*, by the large fan-shaped setae 5 and 6 on the

prothorax (Fig. 50). A few *Topomyia* spp. have well developed stellate setae on the thorax and/or abdomen but these are never so strongly developed as in many *Tripteroides* (Figs. 50b, 52a). The modified mesothoracic seta 6 and/or metathoracic seta 7 (Fig. 52a), when present as they are in the majority of species, are completely diagnostic of *Tripteroides*. *T. (Maorigoeldia) argyropus* is unique in the genus in having a comb with numerous scales in a patch but this species is confined to New Zealand.

53. Two of the three known species of *Topomyia* with strongly developed maxillary horns lack stellate setae on the abdomen. They are, however, readily distinguished from *Malaya* in which, so far as is known, maxillary horns never occur. Horns of this kind are found in various Australasian *Tripteroides* but not in either of the known Australasian *Topomyia* (one undescribed). One species of *Topomyia (T. spathulirostris)* lacks maxillary horns and has the stellate setae poorly developed. It can, however, be easily recognized by the siphon which is much longer than in any *Malaya* (Fig. 53c).

54. A few African, Southeast Asian and Melanesian *Mimomyia* have a piercing siphon (Fig. 54b) but this is much less elaborately modified than in *Mansonia* and there should be no danger of confusion.

55. Most *Culiseta* have a pair of subventral setae arising at or near the base of the siphon and are without other siphonal setae, but only three of them are found in the tropics. Two of these are recognizable by the fact that the comb teeth are arranged in a patch (Fig. 60b) and the third by the presence of a midventral row of setae on the siphon.

56. An additional character is the presence in most *Hodgesia* larvae of several long, very delicate setae on the anal segment anterior to the barred area of the ventral brush (Fig. 57a). These are easily broken off, however, and when this happens their bases are virtually impossible to detect. One or two short, delicate setae anterior to the ventral brush are also sometimes seen in *Ficalbia*.

57. The only culicine genera consistently lacking a pecten are *Armigeres* and *Orthopodomyia*. Among the other genera remaining to be keyed this condition is found in whole or in part in two species of *Culex*, two of *Uranotaenia* and half dozen *Eretmapodites*. The latter are confined to the Ethiopian Region where *Armigeres* is absent and *Orthopodomyia* very rare. They differ from *Orthopodomyia* in many characters including the reduced antennal seta, head setae and ventral brush (Fig. 63a). Of the two *Culex* spp. *C. moucheti* lacks the ventral brush entirely while *C. dispectus* has 4 pairs of subventral tufts on the siphon. The two *Uranotaenia* spp. both occur outside the known geographical range of *Armigeres* and *Orthopodomyia*. One (*U. browni* from the Seychelles) has the siphon densely covered with long spicules. The other (*U. colocasiae* from Fiji) has the ventral brush much as in *Eretmapodites*.

58. One species of *Culiseta*, known only from southern Australia, would run down here instead of to the second half of the couplet. It is easily recognized from any other species with which it might be confused by the long siphon, complete saddle and long head setae 5 and 6 and antennae (Fig. 60c).

59. New World *Uranotaenia* larvae are recognizable also by the more or less thickened, barbed, spinelike head setae 5 and 6, very large comb plate and apically fringed pecten scales. Many of the Old World species

also exhibit some or all of these characters but some do not and for these the only absolutely diagnostic character is the absence or extreme reduction of the maxillary suture (Fig. 61a).

60. The only species likely to be confused are some *Aedes* subgenus *Stegomyia*. These are easily recognized by the long, slender, non-plumose setae of the ventral brush (Fig. 63b). Most of them also differ in having the comb teeth in a single row and in the more numerous pecten teeth. A character which is completely diagnostic for *Eretmapodites*, when present, is the occurrence of rugose, sclerotized bosses at the bases of the principal lateral abdominal setae (Fig. 63c).

61. Among the remaining Southeast Asian genera with a single pair of subventral setae on the siphon *Heizmannia* is distinguished by the much more strongly developed head seta 7 (and usually also 5) and less strongly spiculate saddle edge (Fig. 65b). Many *Aedes* differ in having head seta 7 (at least) more strongly developed or the comb teeth in more than one row. Those which do not differ in either of these characters, e.g. most *Stegomyia* are distinguished by having the saddle edge finely spiculate at most while some also differ in having the comb teeth arising from a sclerotized plate. One Southeast Asian *Finlaya* (*Aedes harperi* from the Philippines) seems from the published description to be distinguishable only at the species level.

62. Larvae of this genus closely resemble those of some *Aedes*. They often have a characteristic head seta 6 with two unequal branches (Fig. 65b). This, when present, is absolutely diagnostic except from *Aedes* subgenus *Christophersiomyia*, easily recognized by the much smaller head seta 4 (Fig. 66a) and one or two *Aedes (Finlaya)* spp. differing in other characters given in the key. *Ae. (Christophersiomyia)* spp., like many other *Aedes*, are also distinguished by the fact that head seta 6 arises only very slightly, if at all, anterior to 7. *Aedes* spp. resembling *Heizmannia* in the well developed head seta 4 and the position of head seta 6, e.g. many *Ae.* (*Stegomyia)* spp., can be recognized by the feebly developed head seta 7 (Fig. 62b). Other characters serving to separate a few doubtful species are the presence of stellate setae on thorax and abdomen (Fig. 66b) or the possession of a spiculated thoracic and abdominal integument.

63. Larvae of subgenus *Psorophora* s. str. have the mouthbrushes modified for predation (Fig. 67a) and are unlikely to be mistaken for anything else. Those of the other subgenera show some resemblances to *Aedes*. However, most New World *Aedes* have the comb teeth in two or more rows while those which do not either have the saddle incomplete (Fig. 67c) or the ventral brush confined to that part of the anal segment which is not ringed by the saddle (Fig. 67d). None of them have the comb arising from a sclerotized plate as in many *Psorophora* (Fig. 67b). Some *Haemagogus* have the comb arising from a small sclerotized plate but these all have the saddle incomplete and lack the anterior extension of the ventral brush. They are also distinguished by the much reduced antenna (Fig. 68a).

64. Most New World *Aedes* are distinguishable from *Haemagogus* either by the longer or more strongly spiculate antenna, position and branching of the head setae, complete saddle or absence of lateral sclerotizations from the barred area at the base of the ventral brush (Fig. 68b) or by a combination of these. There remain a number of *Aedes*, particularly in the subgenera *Finlaya* and *Howardina*, which are best separated at the species level.

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Palaearctic Region

Gutsevitch et al. (1970), Guy (1959), Kramar (1958), La Casse & Yamaguti (1950), Mattingly & Knight (1956), Mihalyi (1963), Mohrig (1969), Natvig (1948), Rioux (1958), Senevet & Andarelli (1959), University of Maryland (1963).

Ethiopian Region

Edwards (1941), Gillies & de Meillon (1968), Grjebine (1966), Haddow et al. (1951), Hamon (1963), Hopkins (1952), Leeson (1958), Mattingly (1952, 1953), Mattingly & Brown (1955), Mattingly & Lips (1953), Muspratt (1955, 1956), Ovazza et al. (1956), Van Someren et al. (1955).

Oriental Region

Barraud (1934), Bonne-Wepster (1954), Borel (1930), Bram (1967a), Christophers (1933), Delfinado (1966), Lien (1968), Macdonald (1957, 1960), Mattingly (1965), Reid (1968), Reuben (1969), Thurman (1959), Tyson (1970), Wharton (1962).

Australian Region (including Micronesia)

Belkin (1962, 1968), Bohart (1956), Dobrotworsky (1965), Huang (1968a, b), Marks (1954), O'Gower (1958), Ramalingam & Belkin (1965), Sirivanakarn (1968), Steffan (1966, 1968), Van den Assem & Bonne-Wepster (1964).

Nearctic Region

Barr (1958), Beckel (1954), Carpenter (1968), Carpenter & La Casse (1955), Darsie (1951), Gjullin et al. (1961), King et al. (1960), Ross & Horsfall (1965), Smith (1969), Steward & McWade (1961), Vockeroth (1954), Zavortink (1970).

Neotropical Region

Belkin et al. (1970), Belkin & Hogue (1959), Berlin (1969a, b), Bram (1967b), Correa & Ramalho (1956), Cova-Garcia (1961), Cova-Garcia et al. (1966), Foote (1954), Forrattini (1962, 1965a, b), Galindo et al. (1954), Garcia & Ronderos (1962), Guedes et al. (1965), Lane (1953), Ronderos & Bachmann (1963b), Schick (1970).

General

Certain of the above overlap two or more adjacent regions, notably Mattingly & Knight, 1956 (Palaearctic, Oriental and Ethiopian), University of Maryland, 1963 (Palaearctic and Oriental), Bonne-Wepster, 1954 (Oriental and Australian), Belkin & Hogue, 1959; Bram, 1967b; Foote, 1954; Galindo et al., 1954; Zavortink, 1970 (Neotropical and Nearctic). Recent taxonomic works with World coverage are Maslov (1967) and Zavortink (1968). Foote & Cook (1959) is useful as a general survey of vector species.

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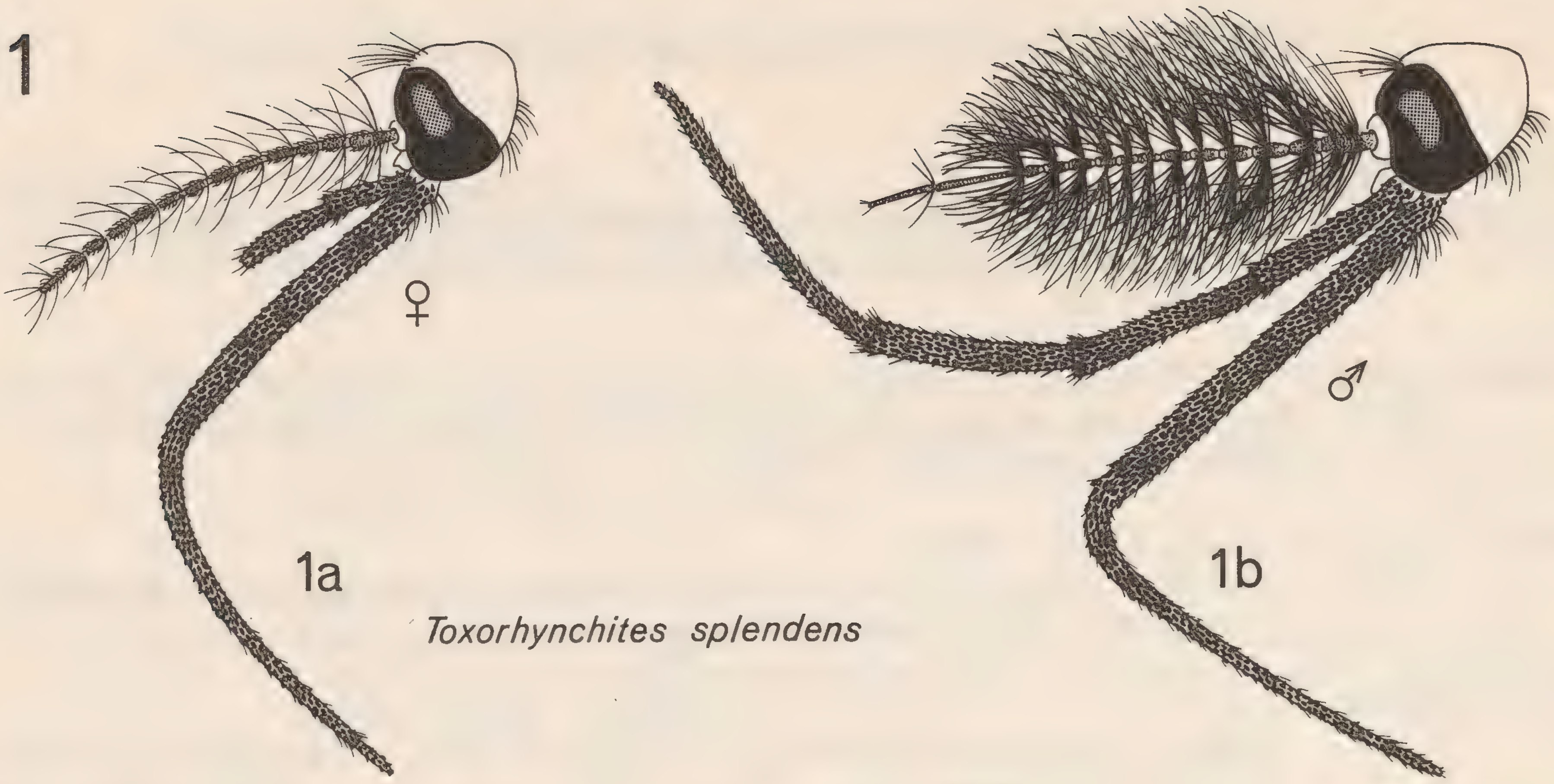
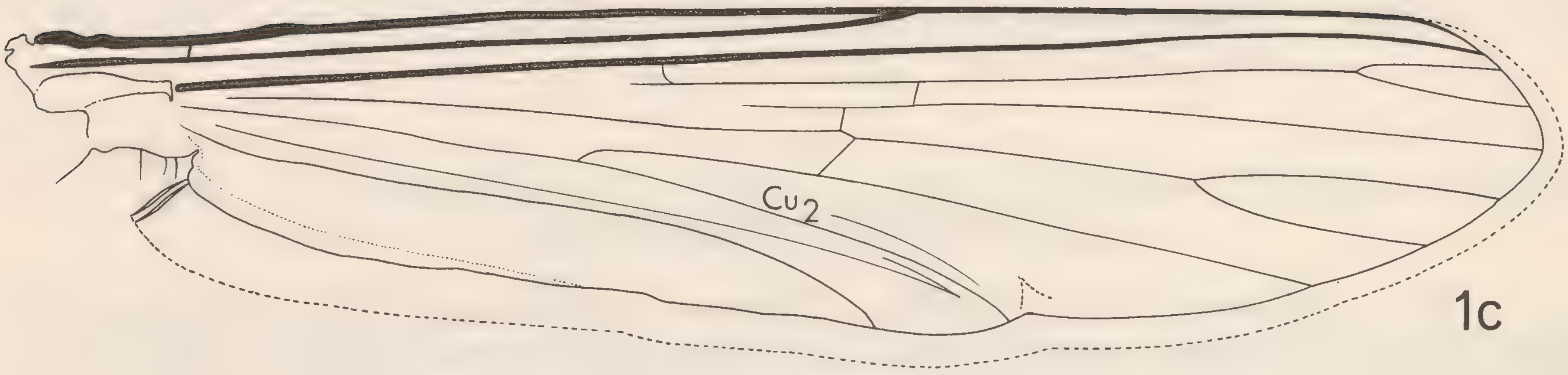
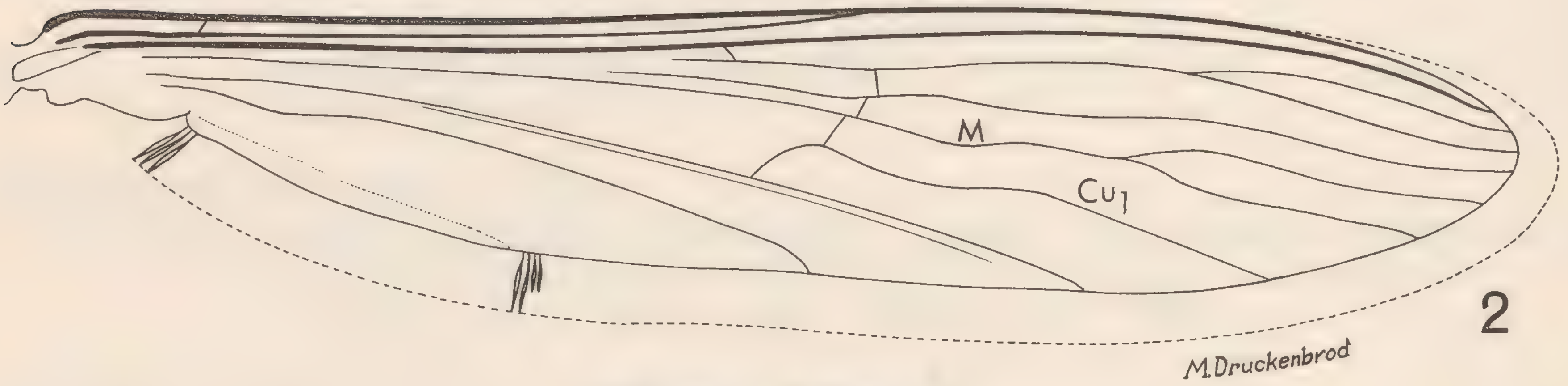
Pl. 1



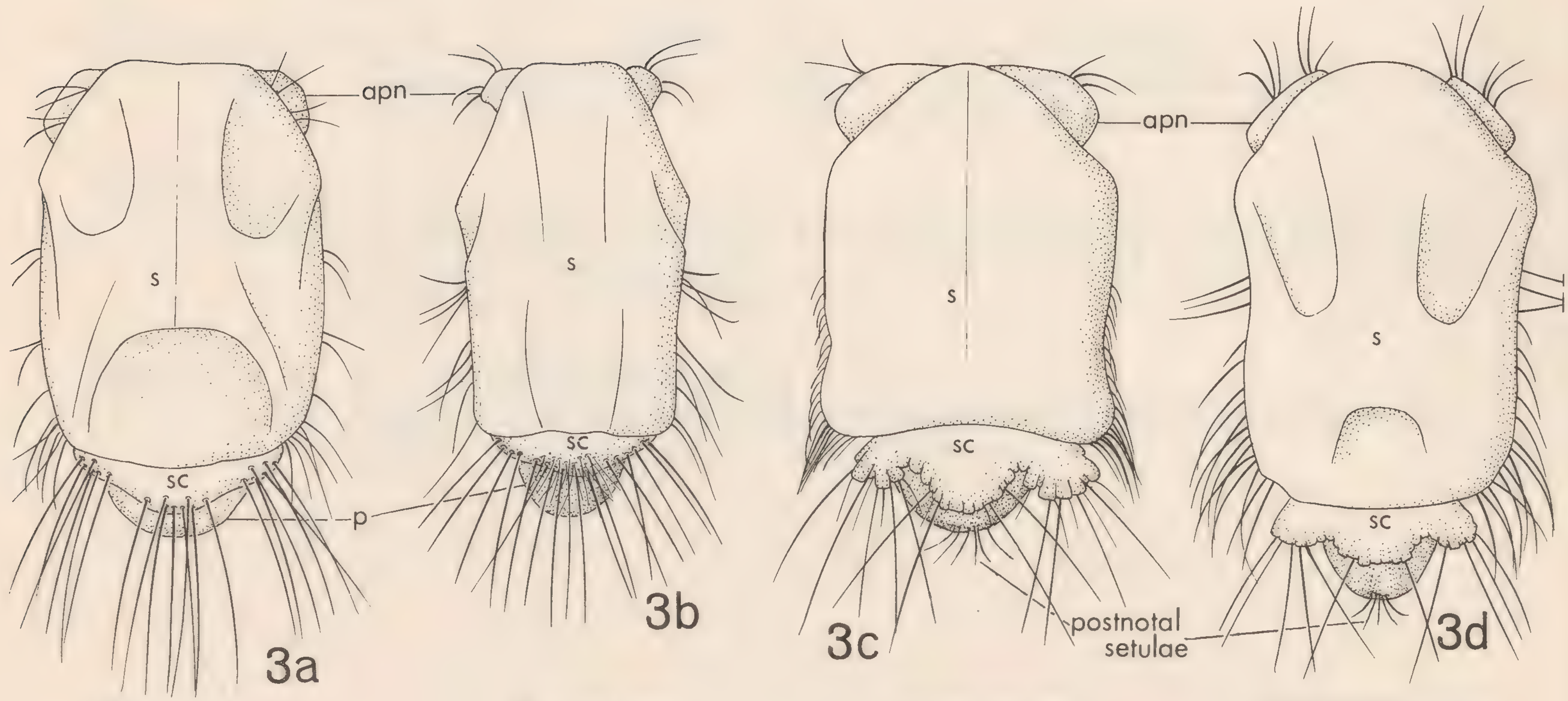
Toxorhynchites splendens



Toxorhynchites splendens



Bironella hollandi



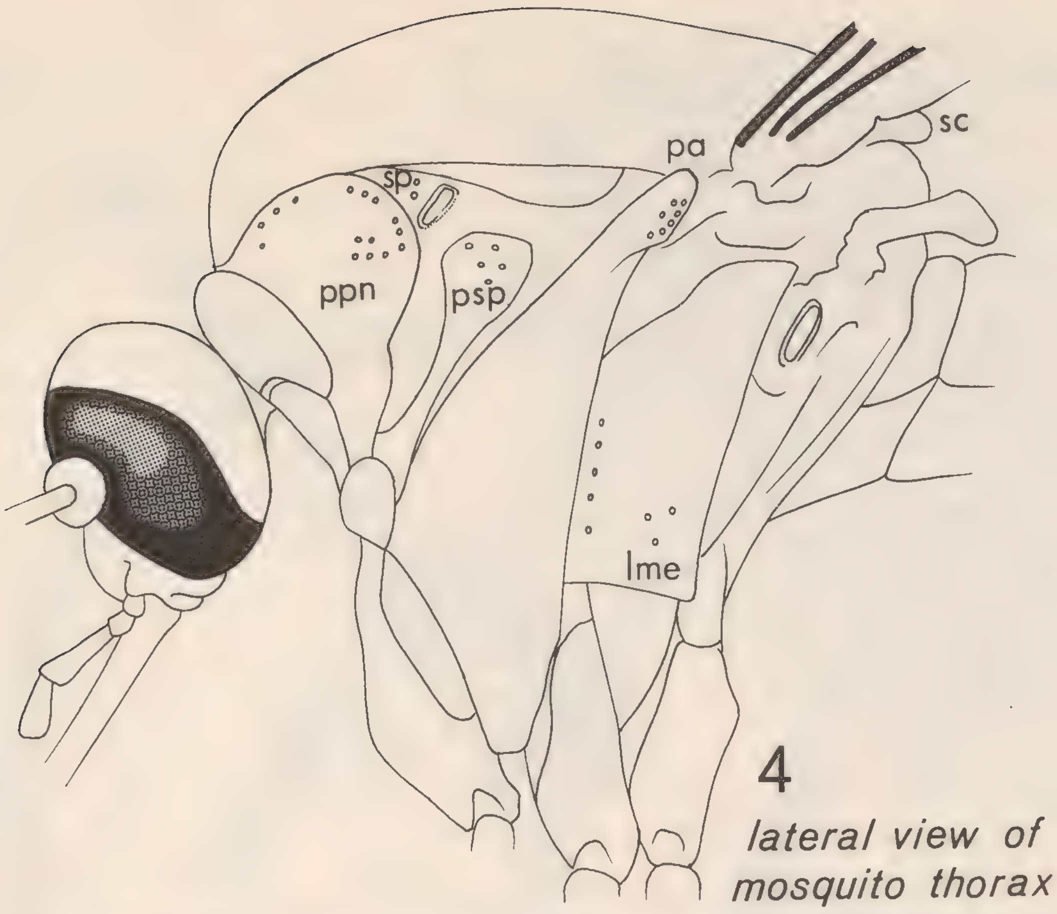
Chagasia fajardoi

Anopheles balabacensis

Wyeomyia aporonoma

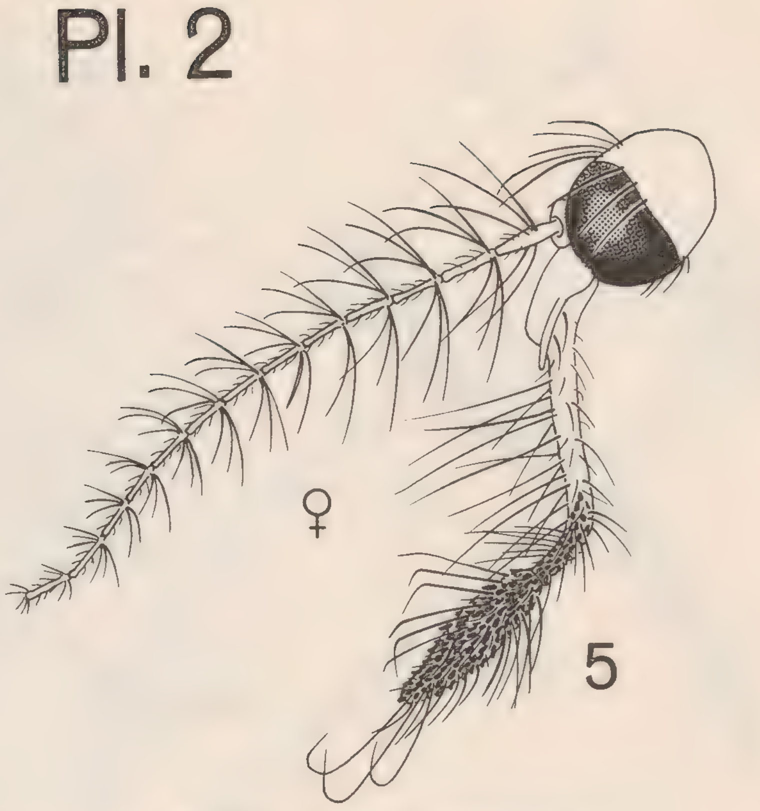
Trichoprosopon digitatum

Pl. 2



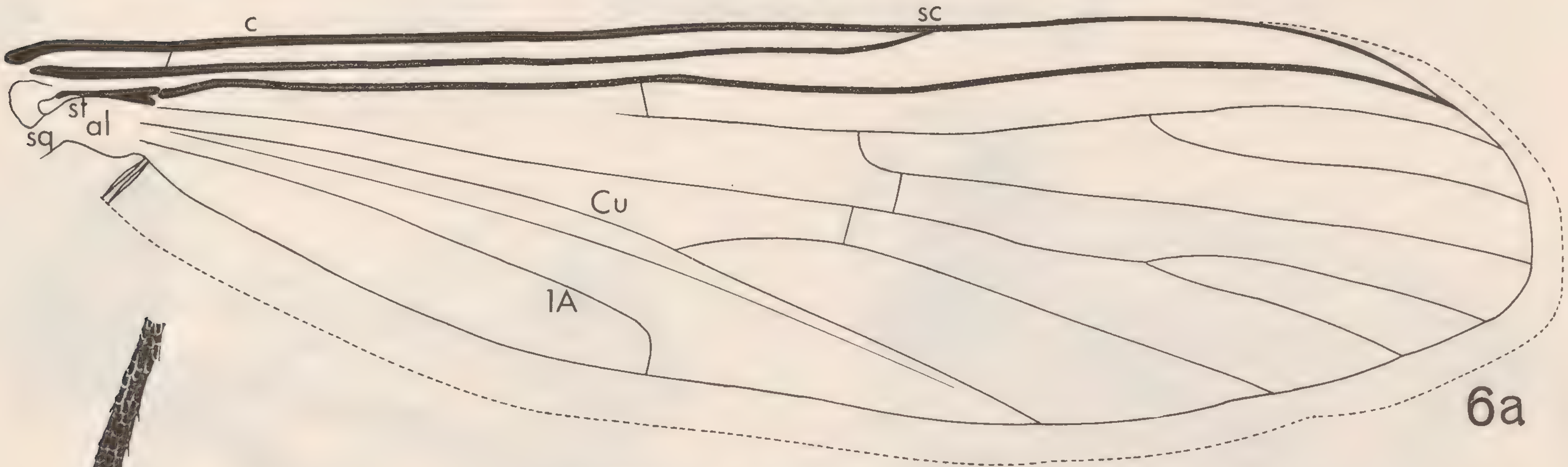
4

lateral view of mosquito thorax



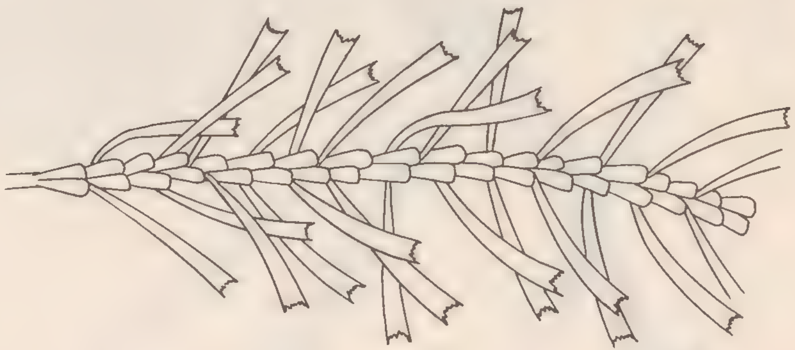
5

Malaya genurostris

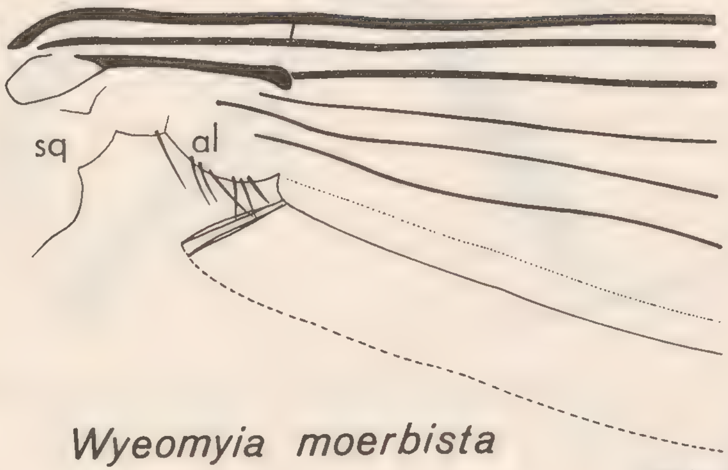


6a

Hodgesia malayi

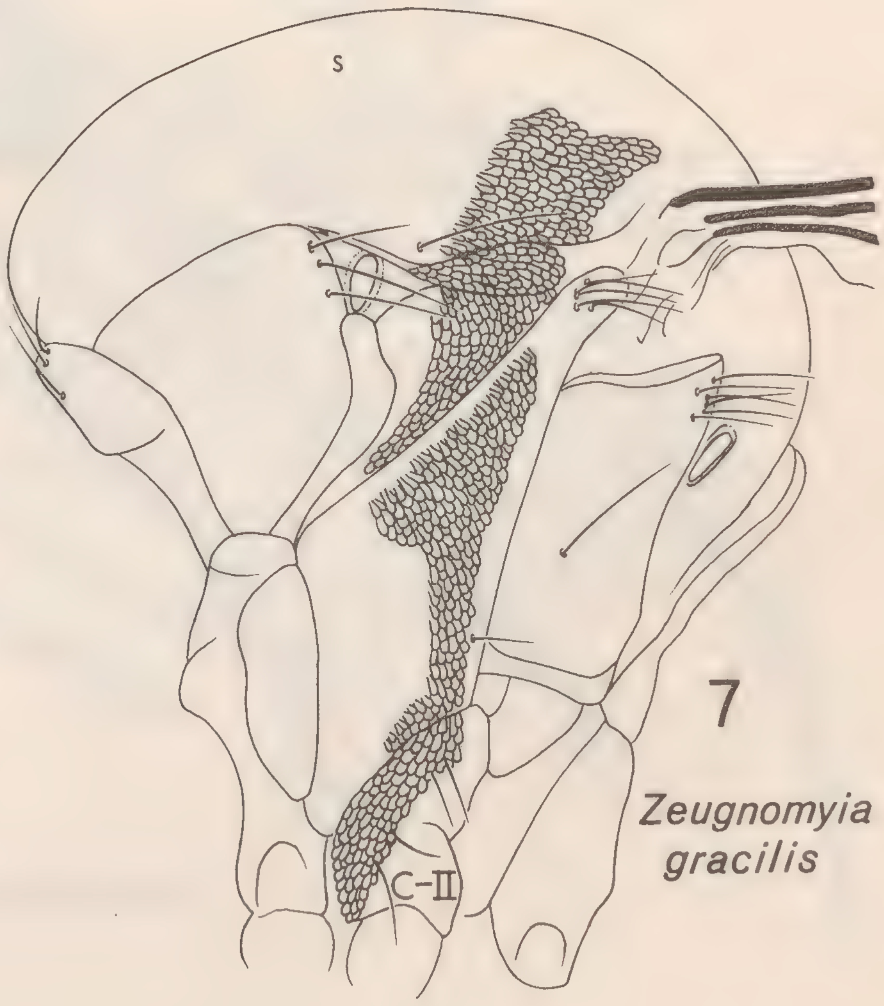


Hodgesia malayi 6b



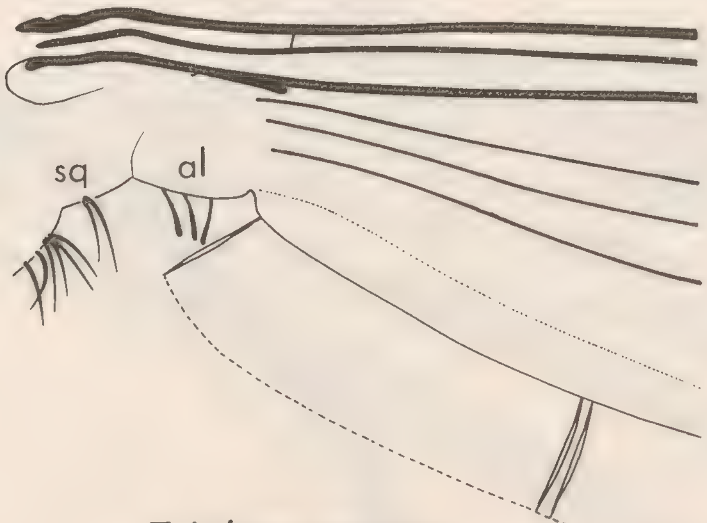
Wyeomyia moerbista

8b



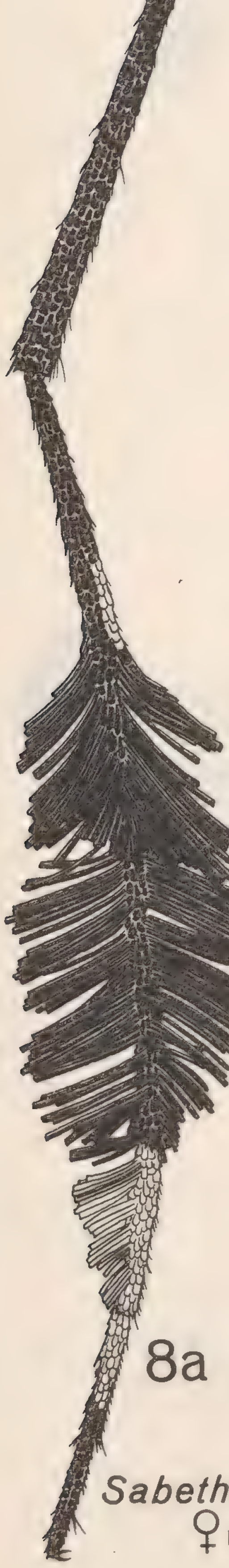
7

Zeugnomyia gracilis



Trichoprosopon pallidiventer

8c

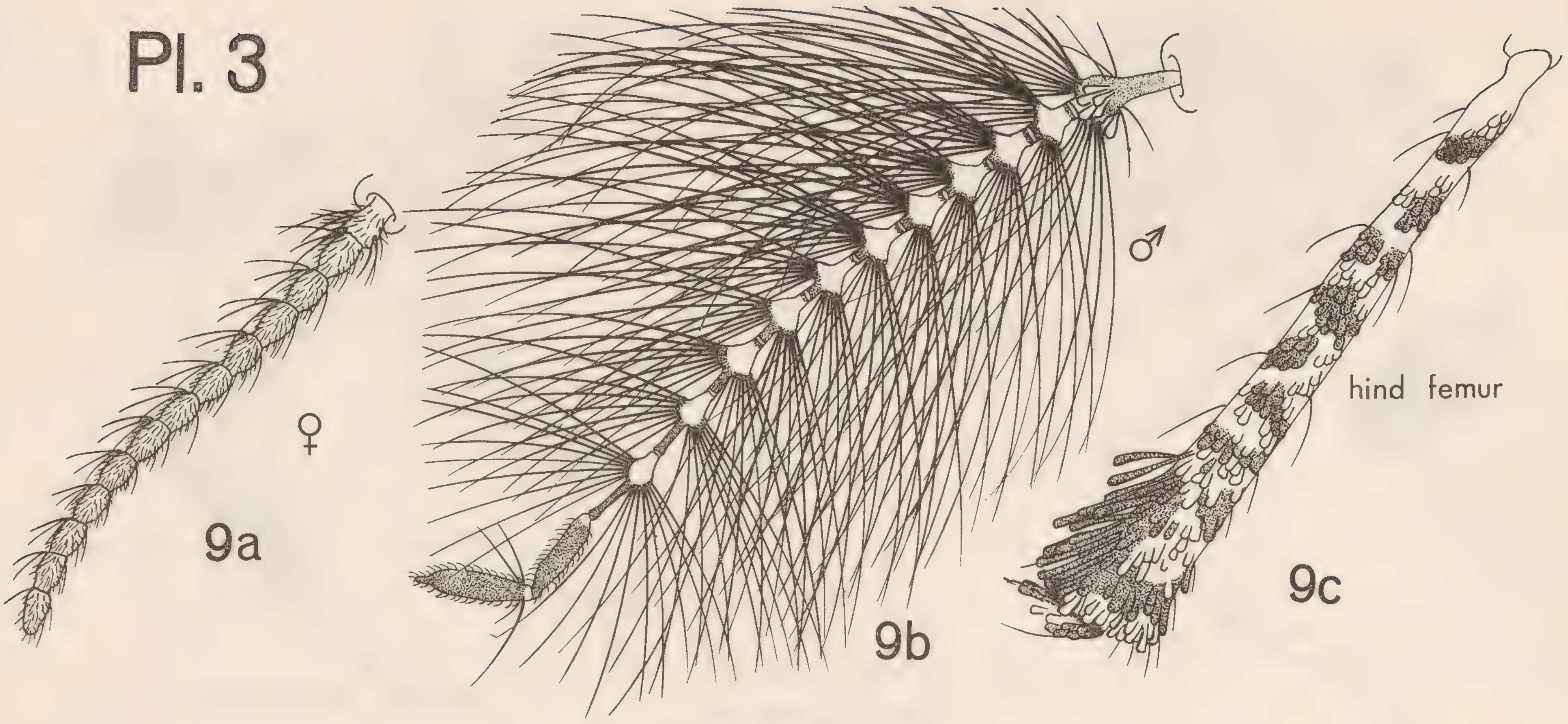


8a

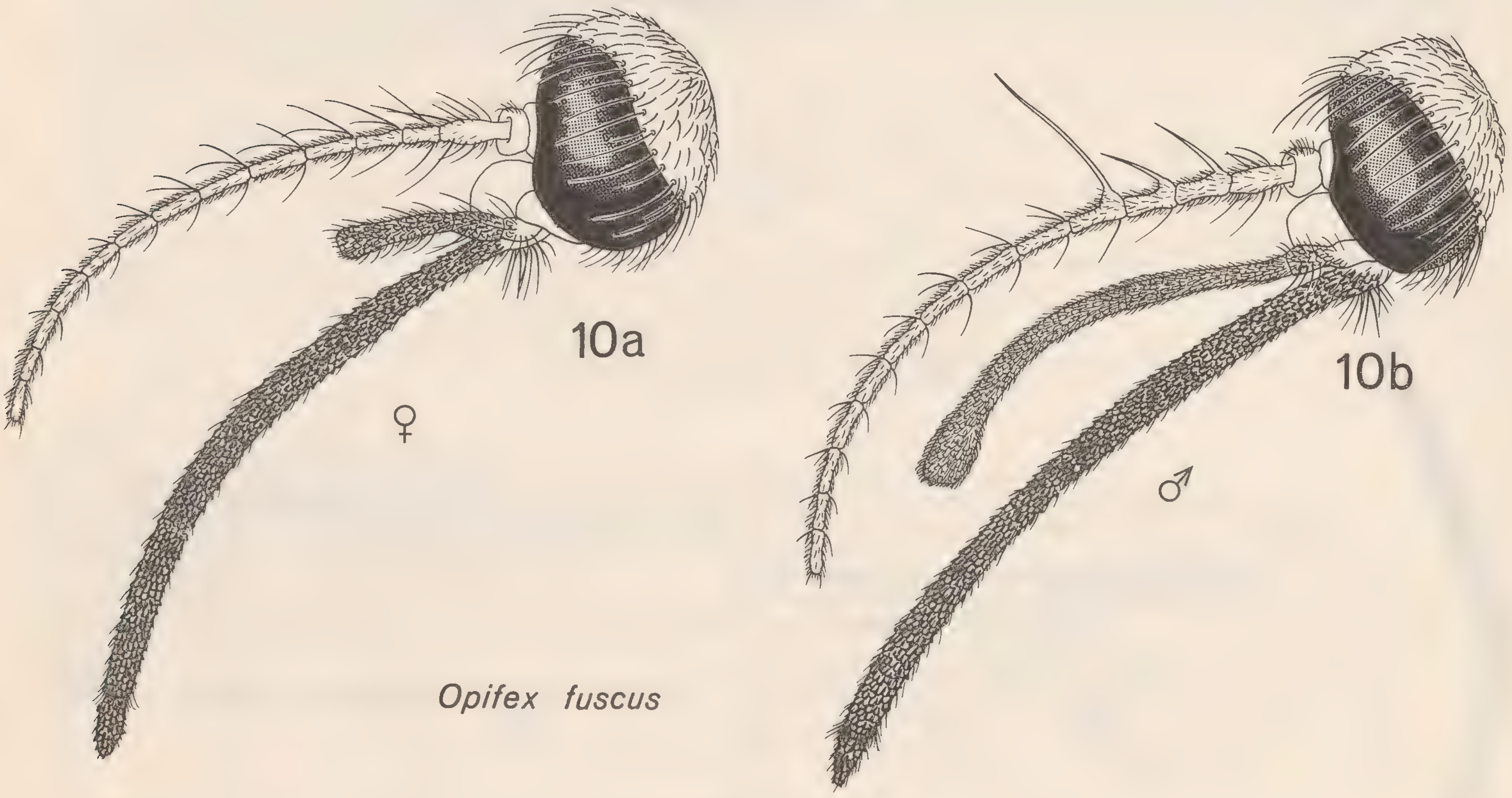
Sabethes belisarioi
♀ mid leg

M. Druckenbrod

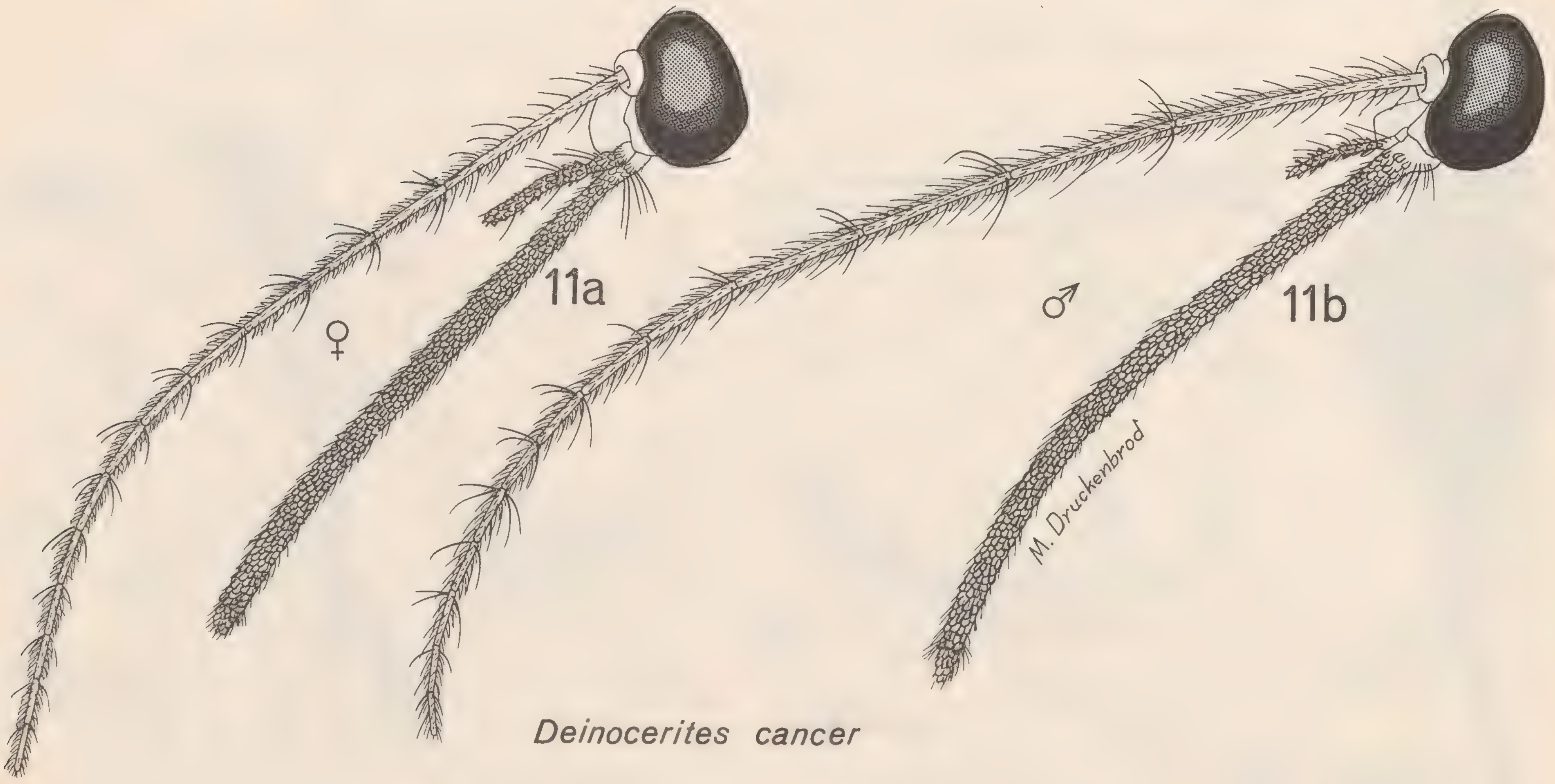
Pl. 3



Aedeomyia catasticta

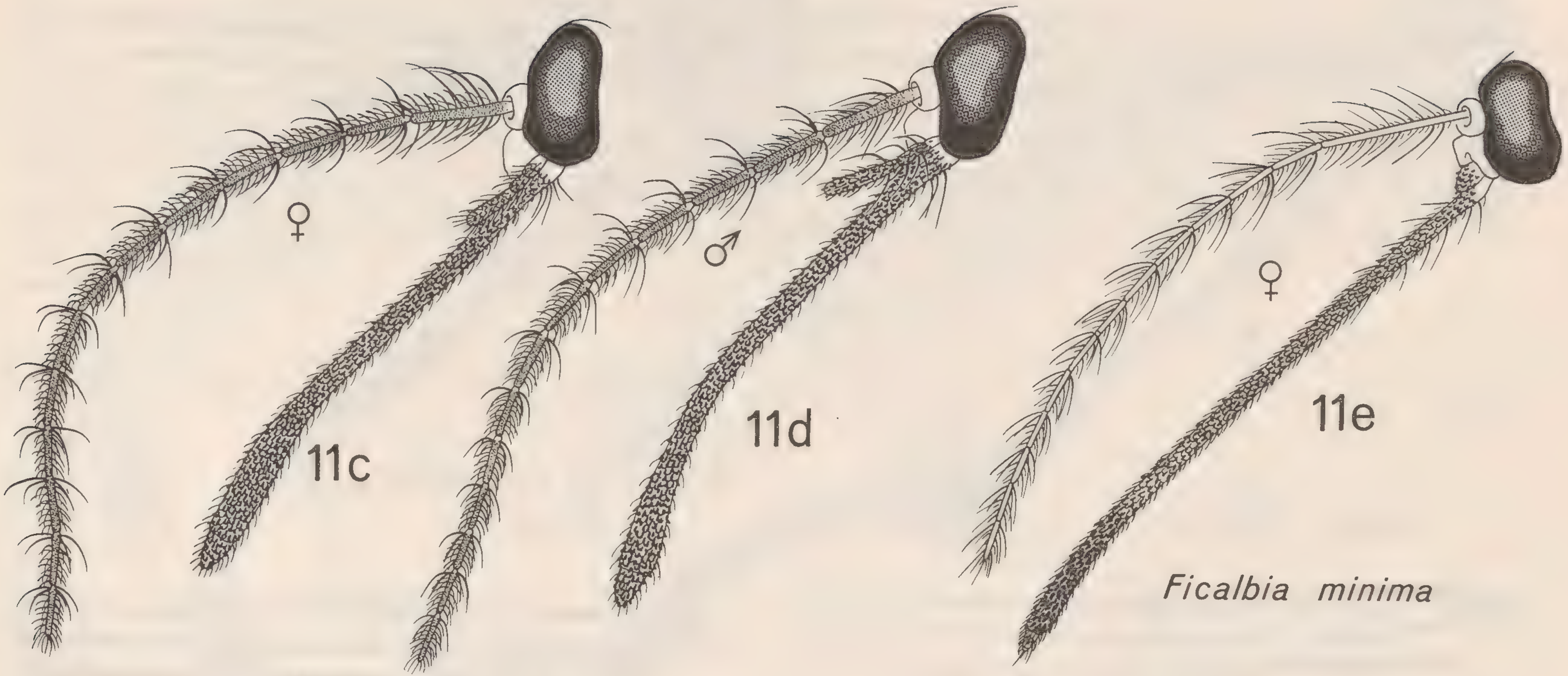


Opifex fuscus



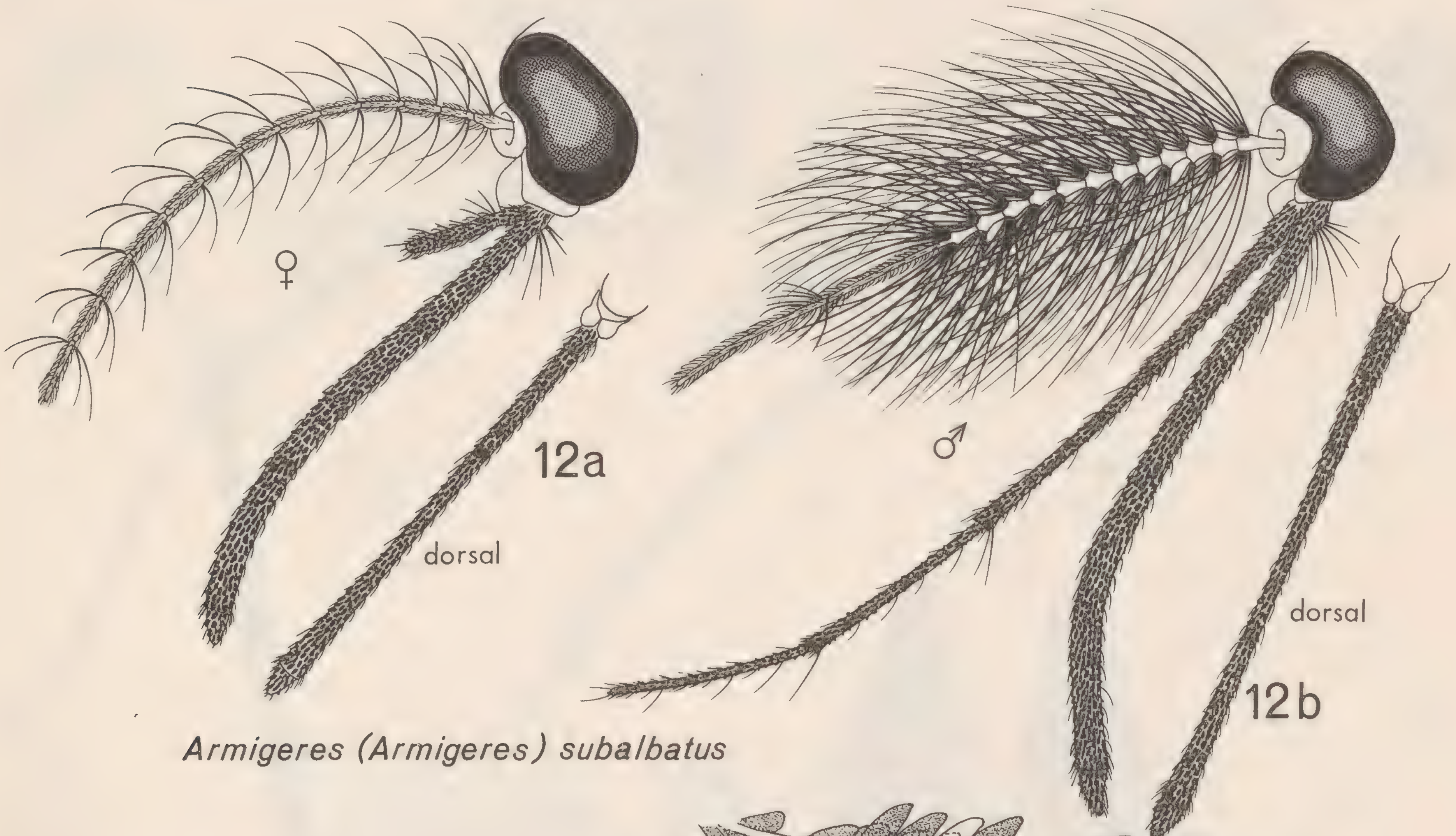
Deinocerites cancer

Pl. 4

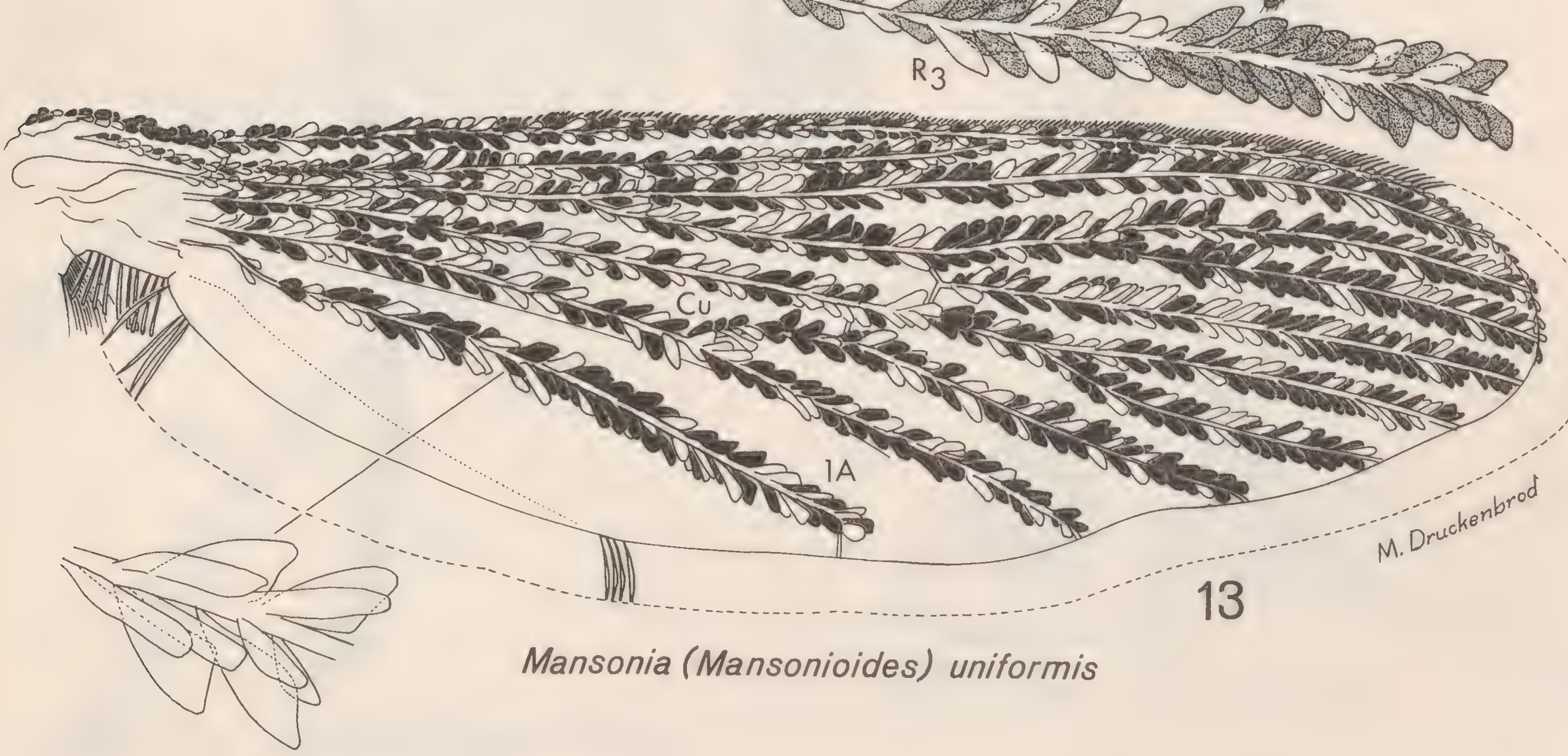


Galindomyia leei

Ficalbia minima

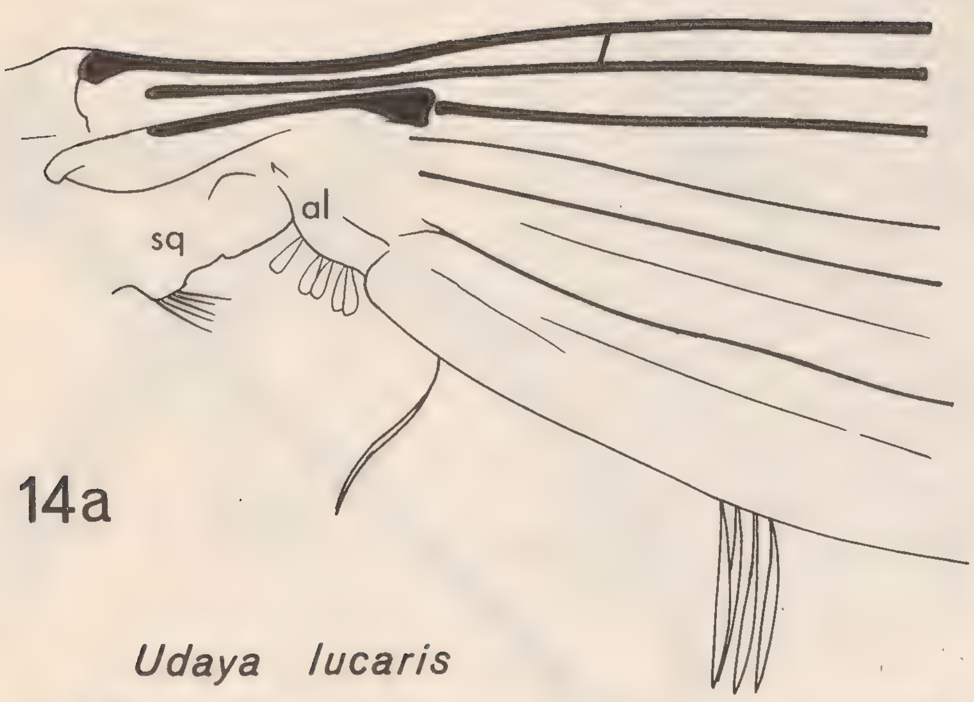


Armigeres (Armigeres) subalbatus



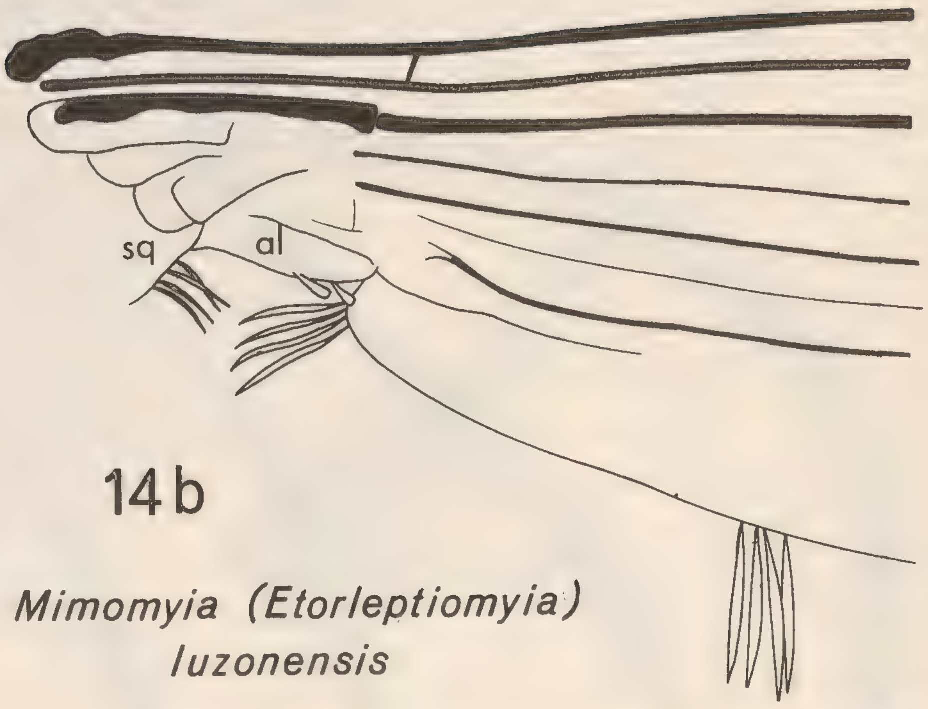
Mansonia (Mansonioides) uniformis

Pl. 5



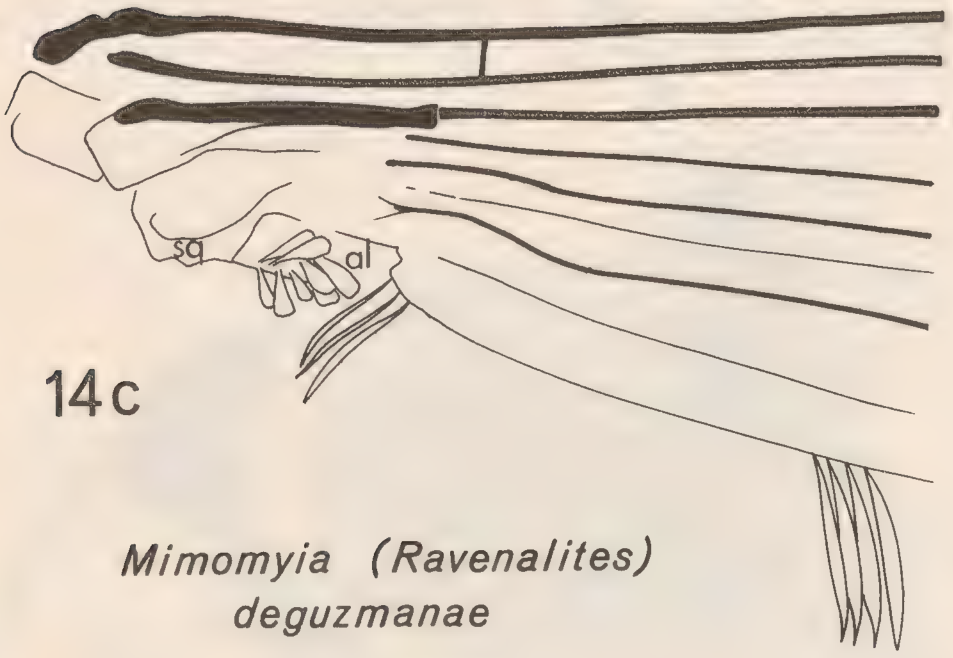
14a

Udaya lucaris



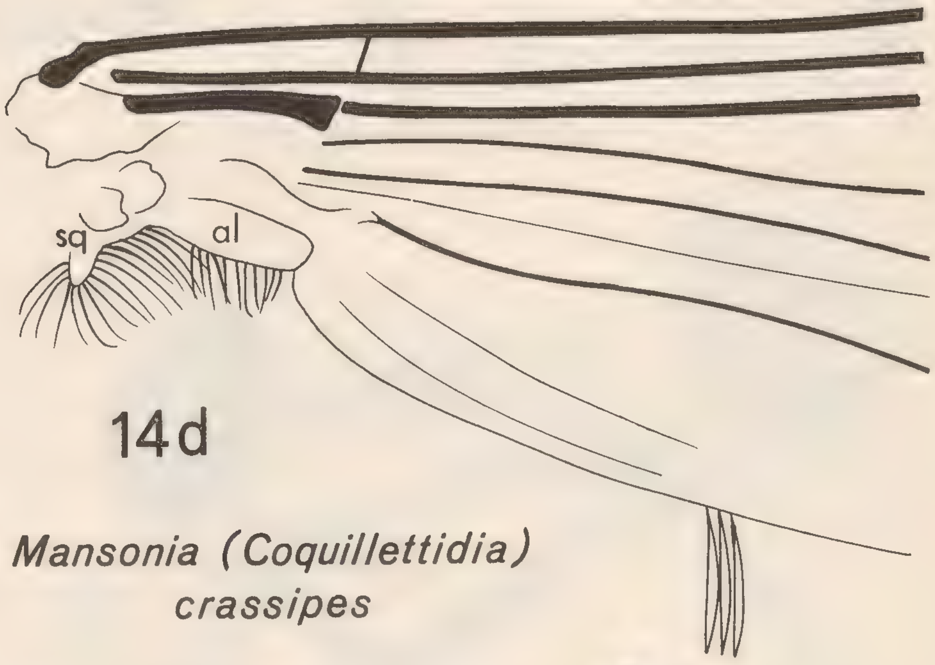
14b

Mimomyia (Etorleptiomyia) luzonensis



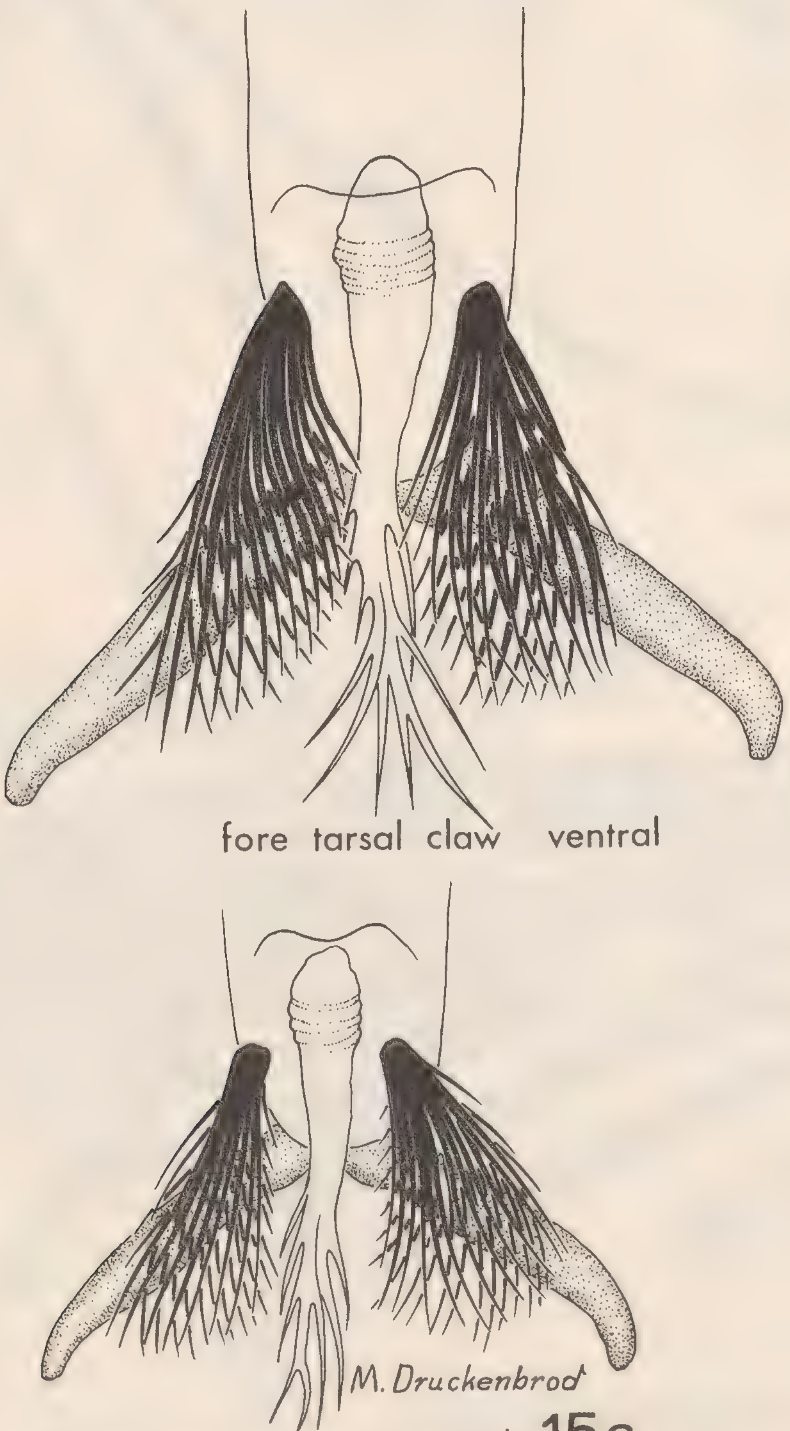
14c

Mimomyia (Ravenalites) deguzmanae



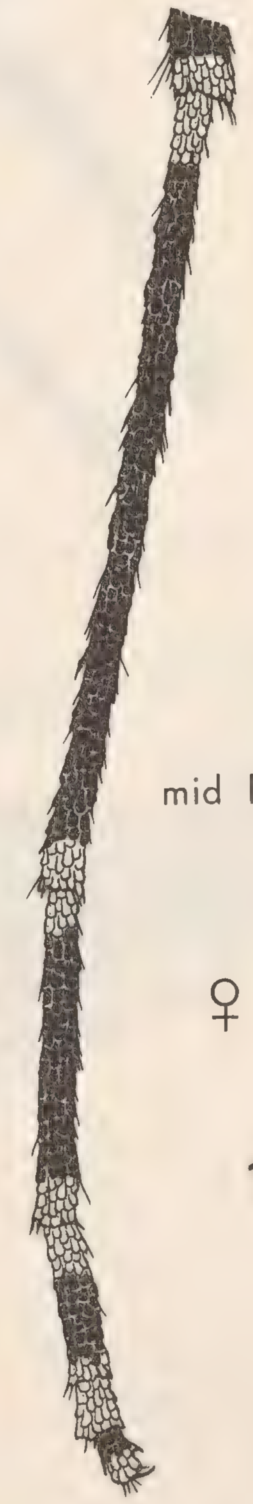
14d

Mansonia (Coquillettidia) crassipes



15a

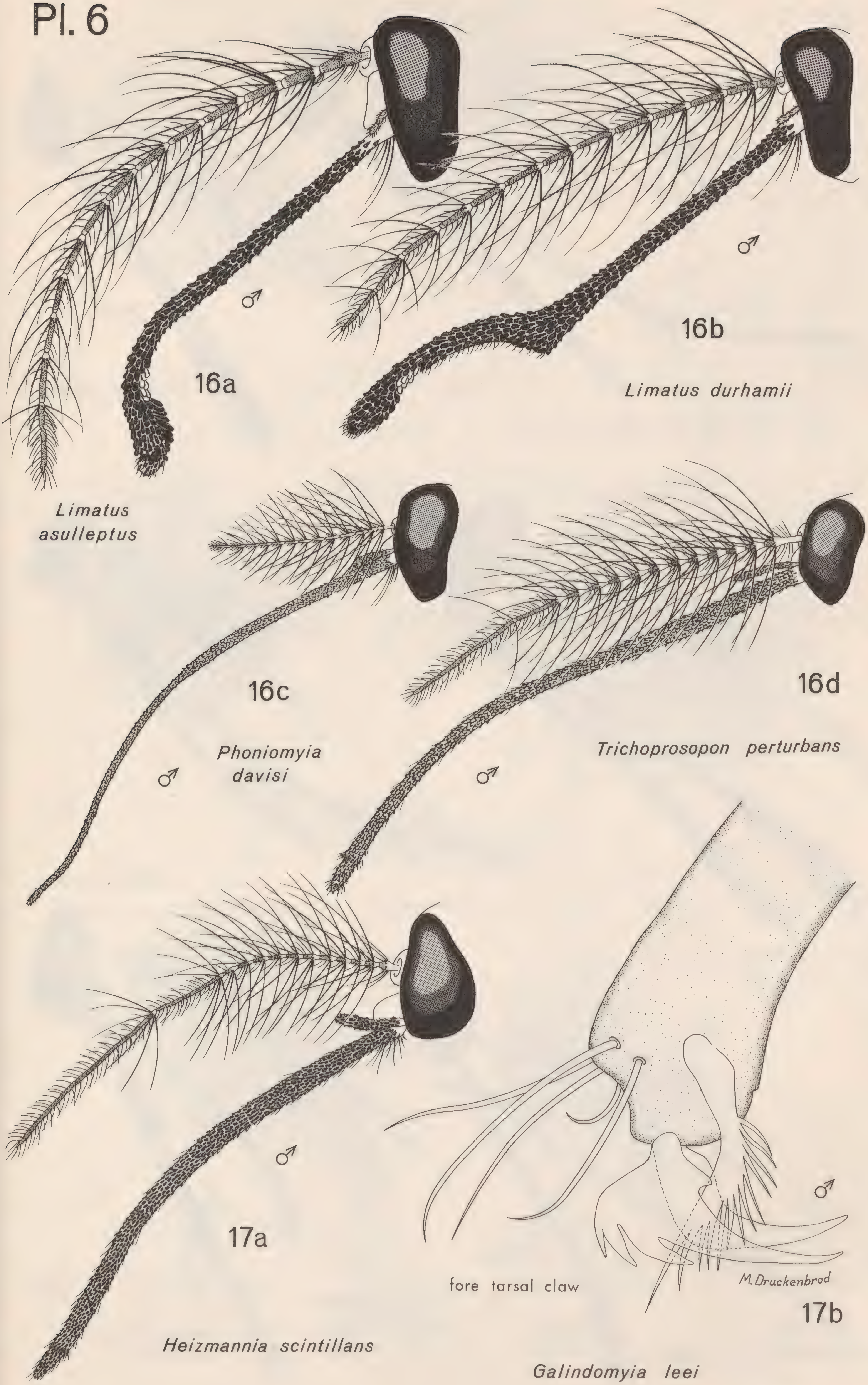
Culex sp.



15b

Orthopodomyia anopheloides

Pl. 6



16a *Limatus asulleptus*

16b *Limatus durhamii*

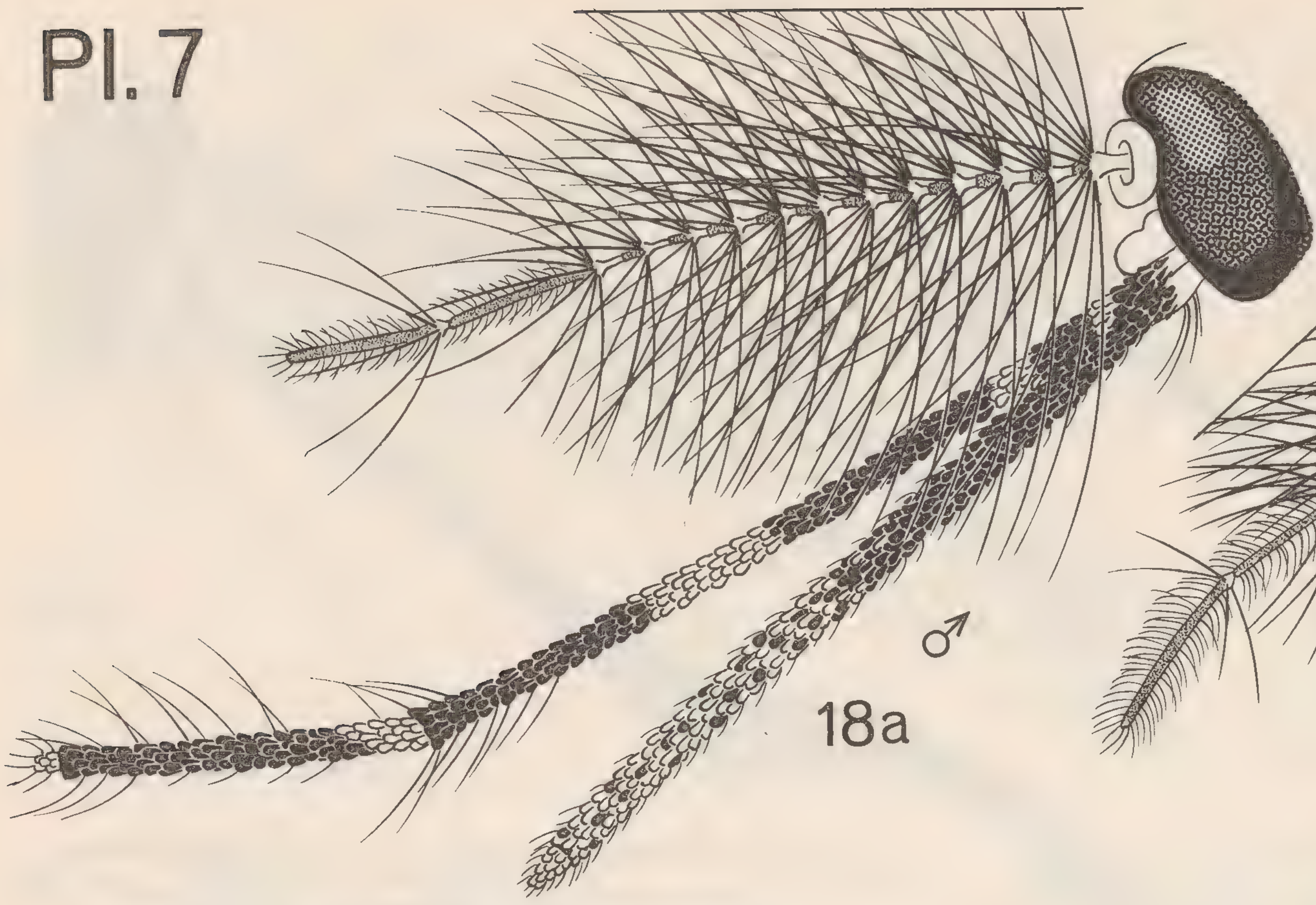
16c *Phoniomyia davisi*

16d *Trichoprosopon perturbans*

17a *Heizmannia scintillans*

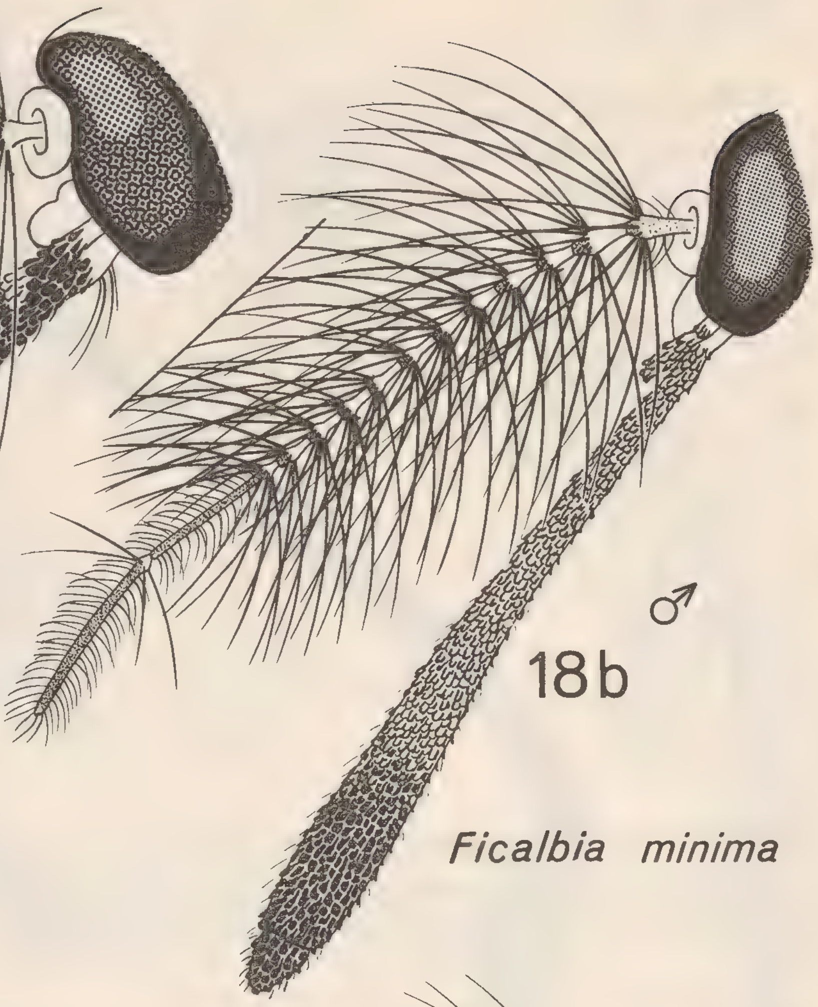
17b *Galindomyia leei*

Pl. 7



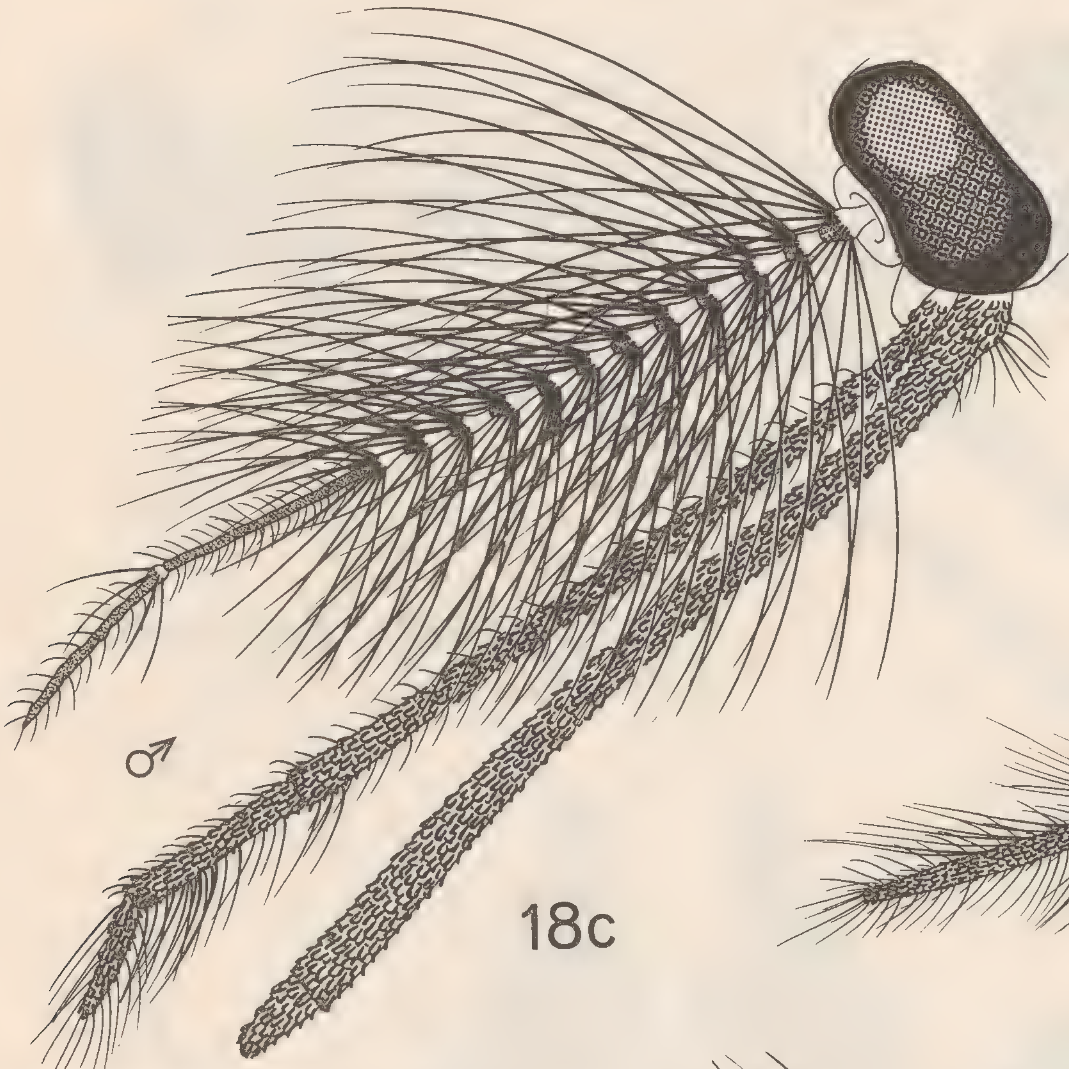
18a

Mansonia (Mansonioides) uniformis



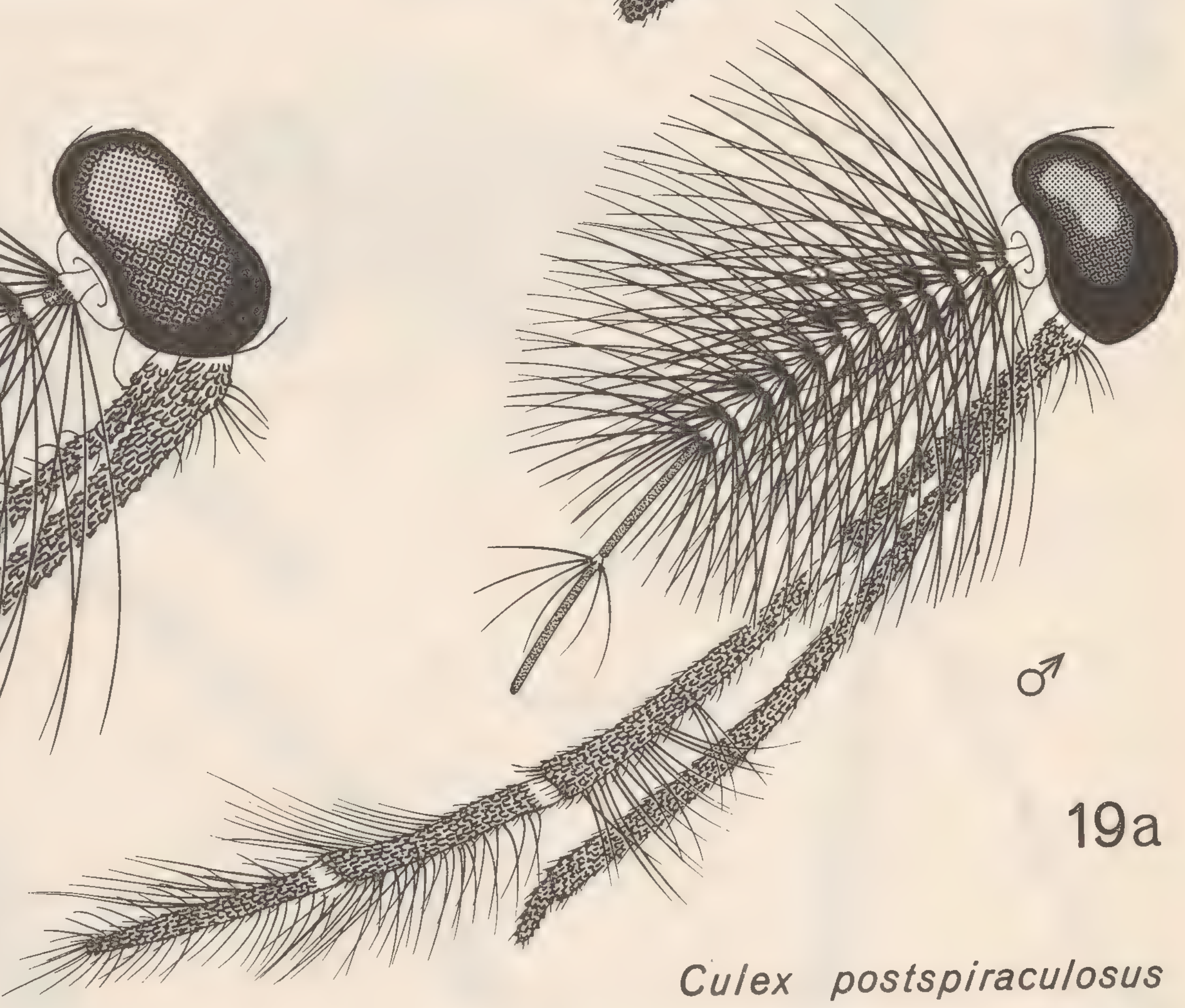
18b

Ficalbia minima



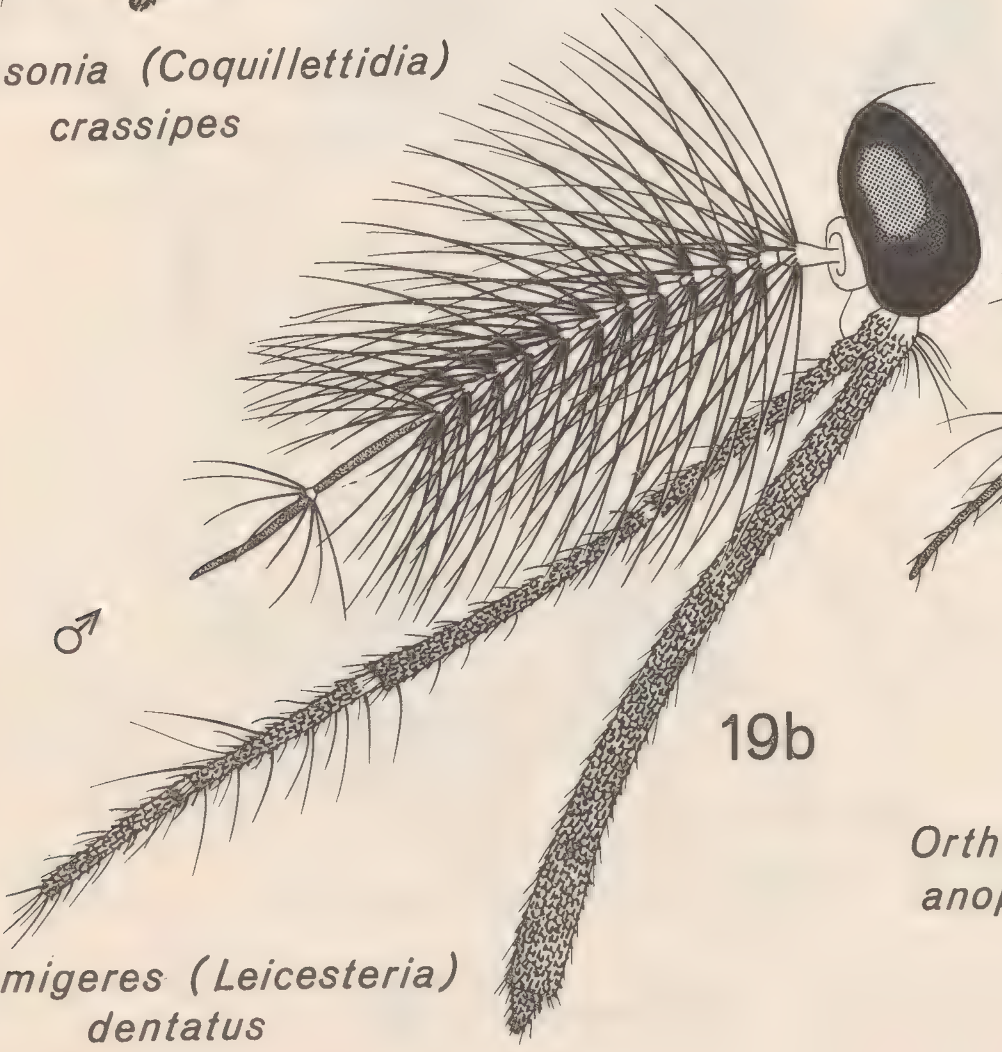
18c

Mansonia (Coquillettidia) crassipes



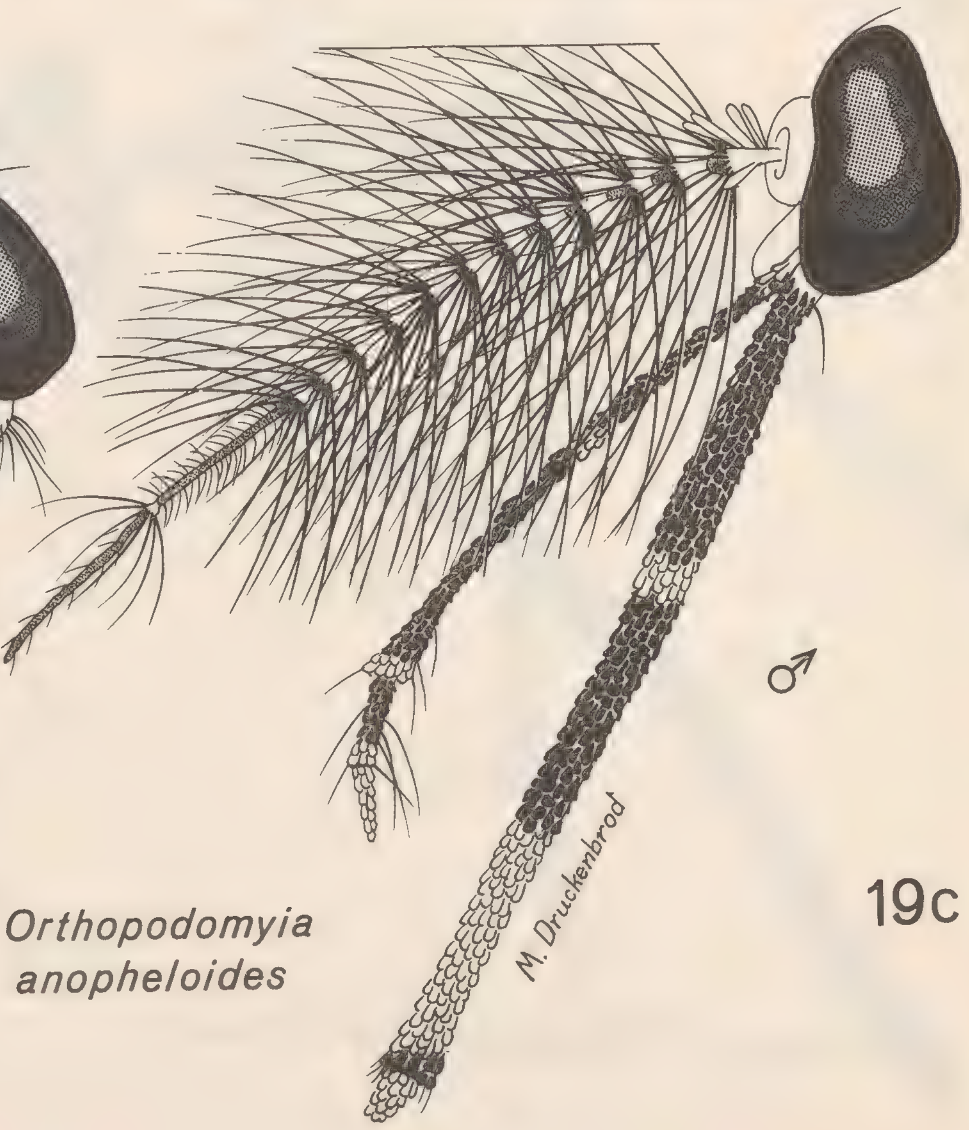
19a

Culex postspiraculosus



19b

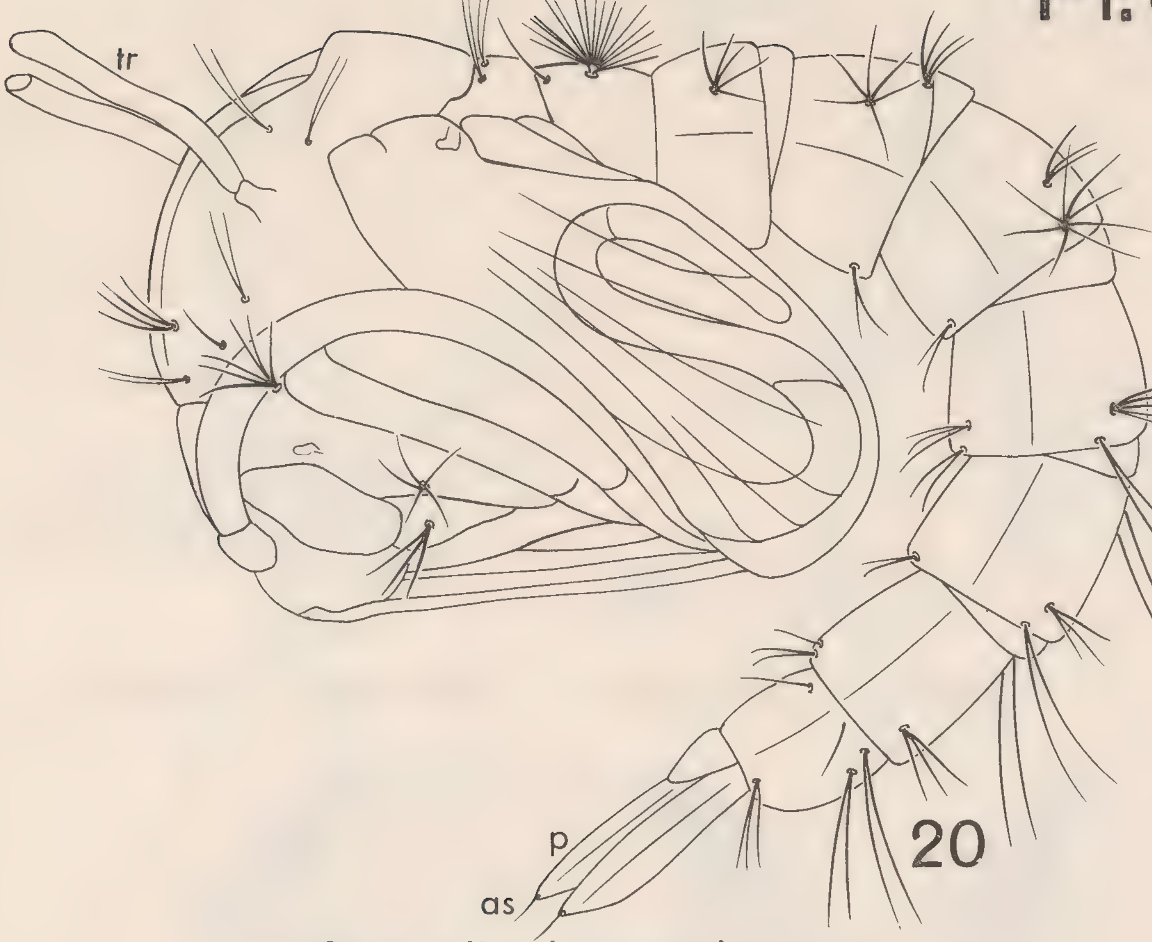
Armigeres (Leicesteria) dentatus



19c

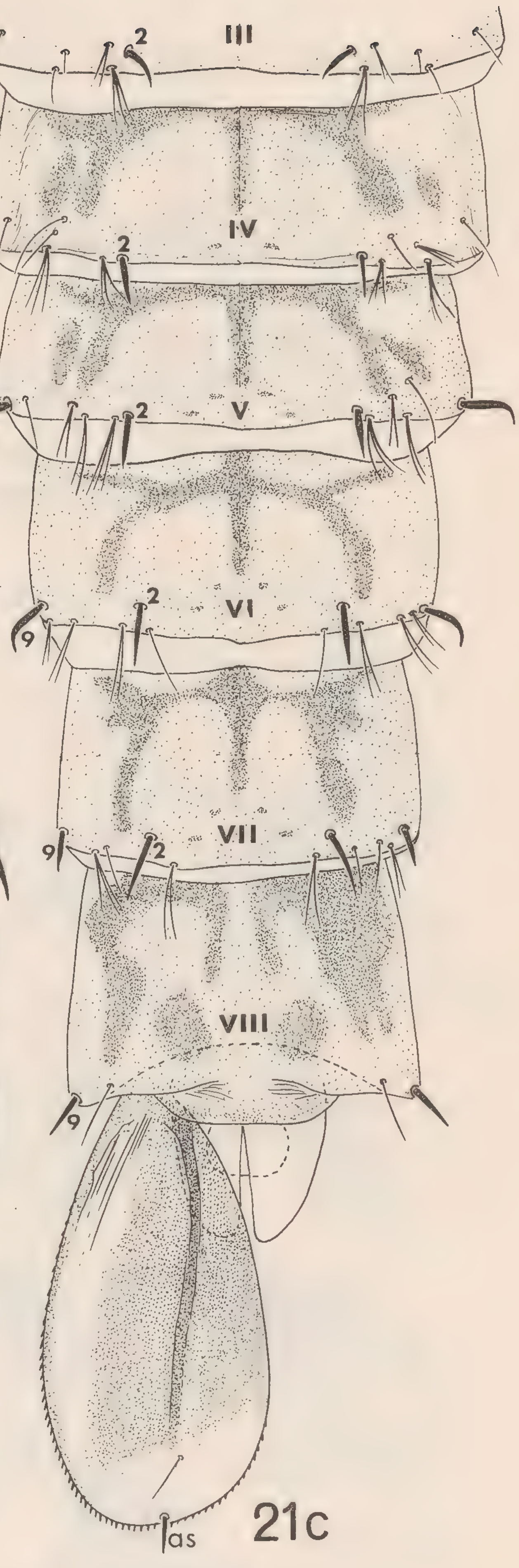
Orthopodomyia anopheloides

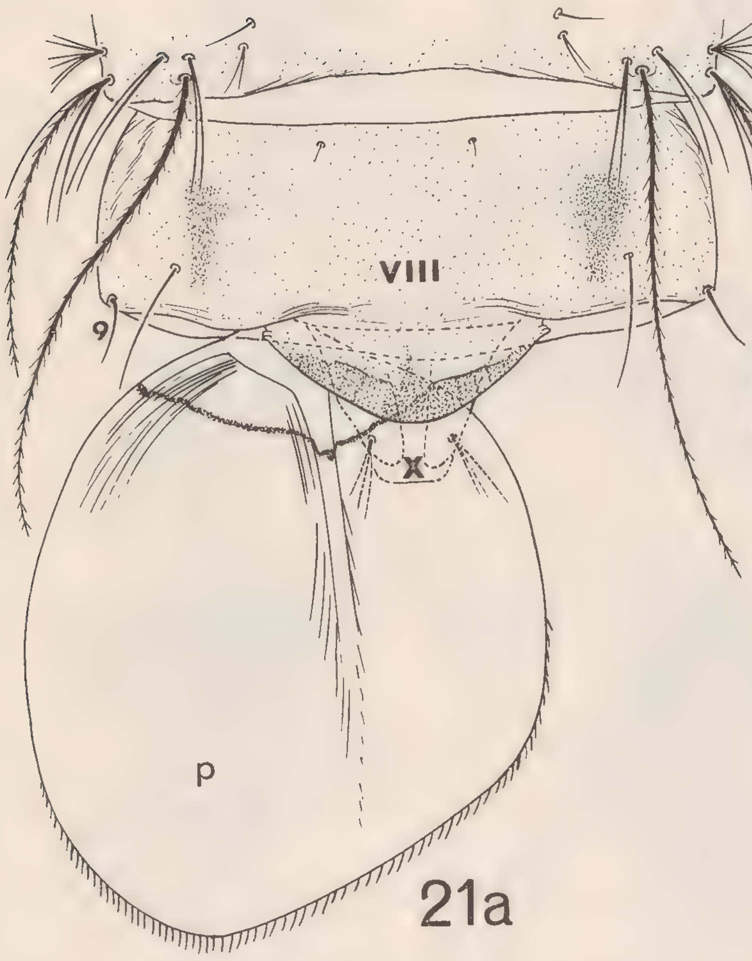
Pl. 8

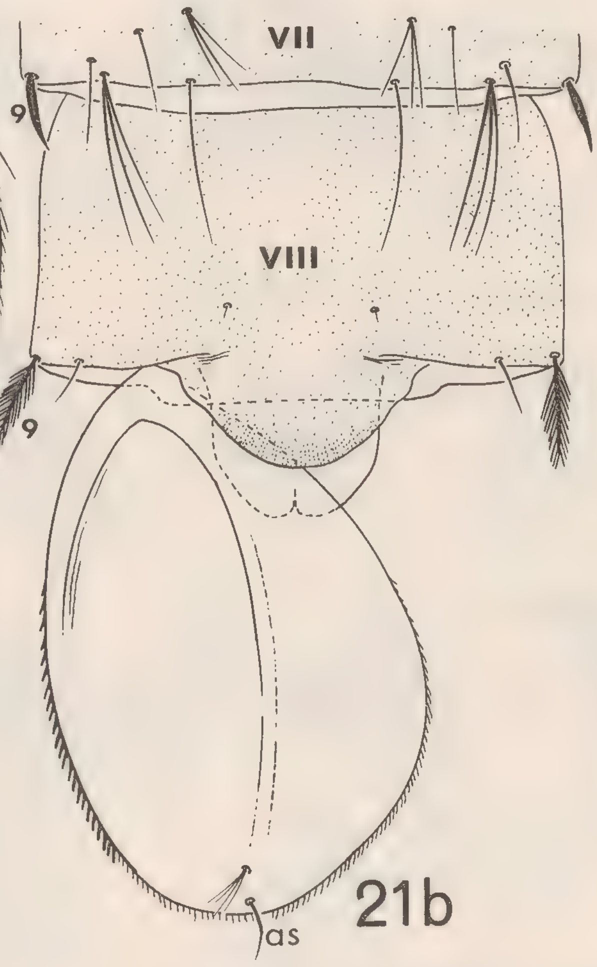


20

Generalized mosquito pupa







21a

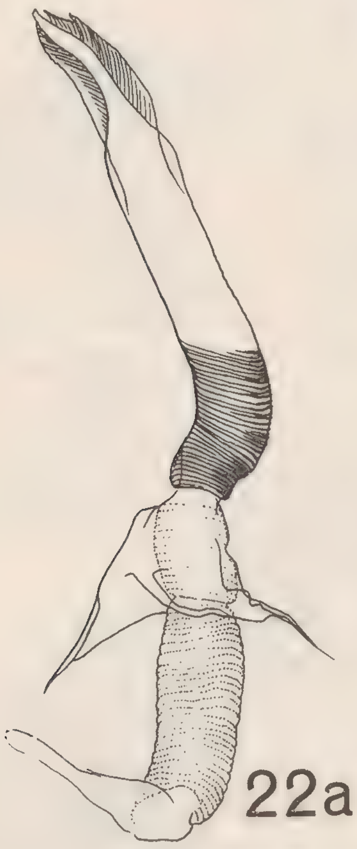
21b

21c

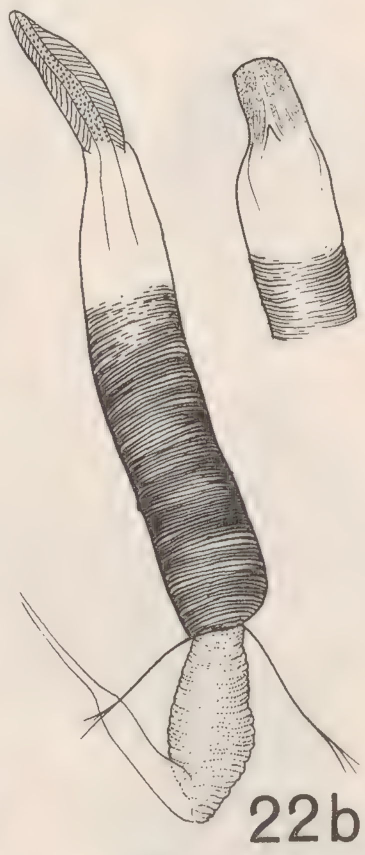
Toxorhynchites splendens

Anopheles balabacensis

Chagasia bathana



22a



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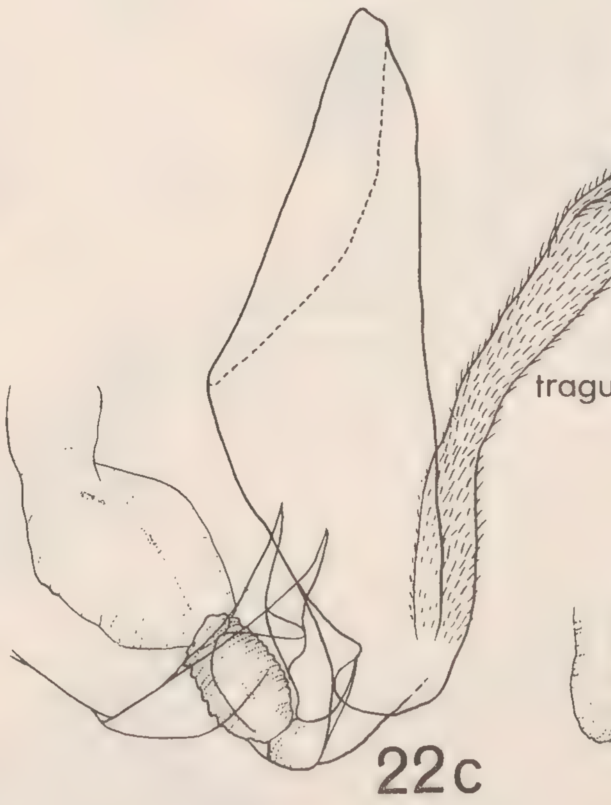

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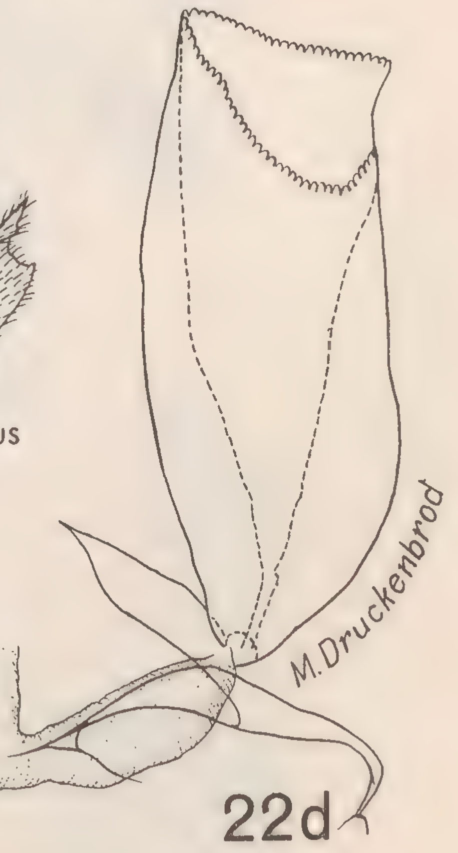

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22d

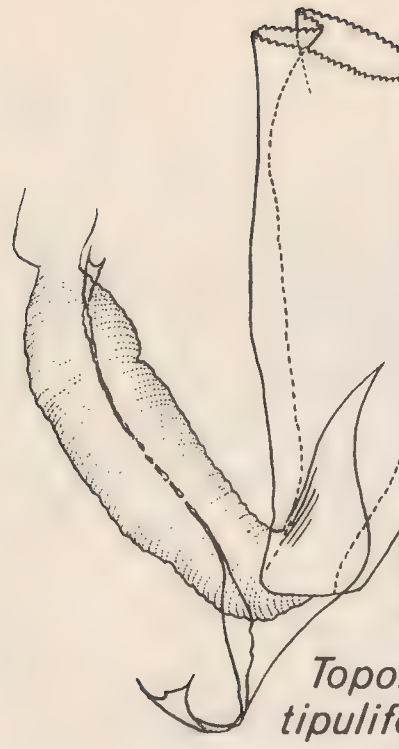
Mansonia (Mansonioides) uniformis

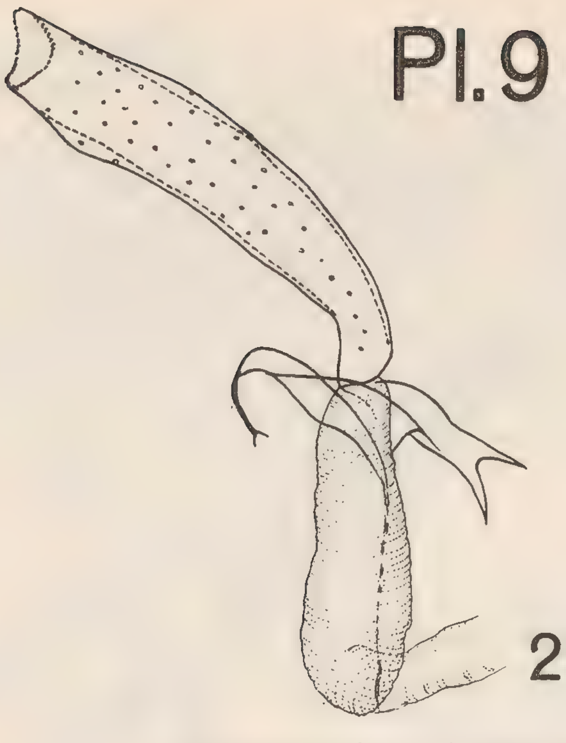
Mansonia (Coquillettidia) microannulata

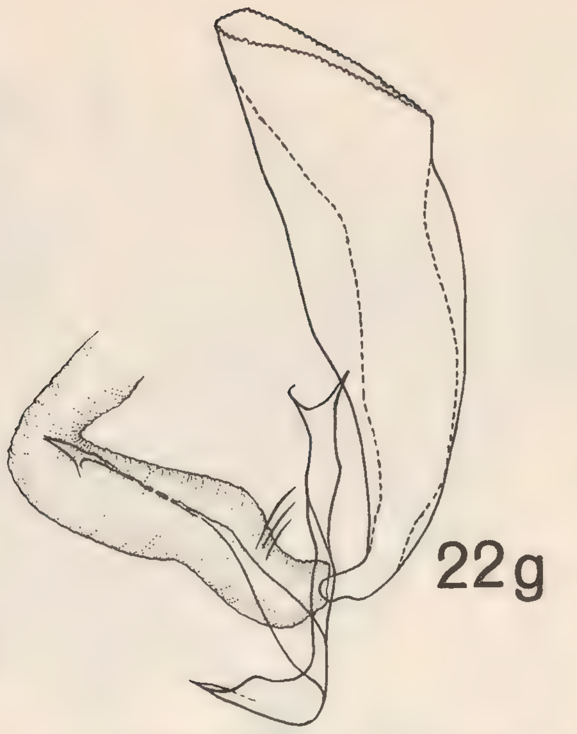
Hodgesia malayi

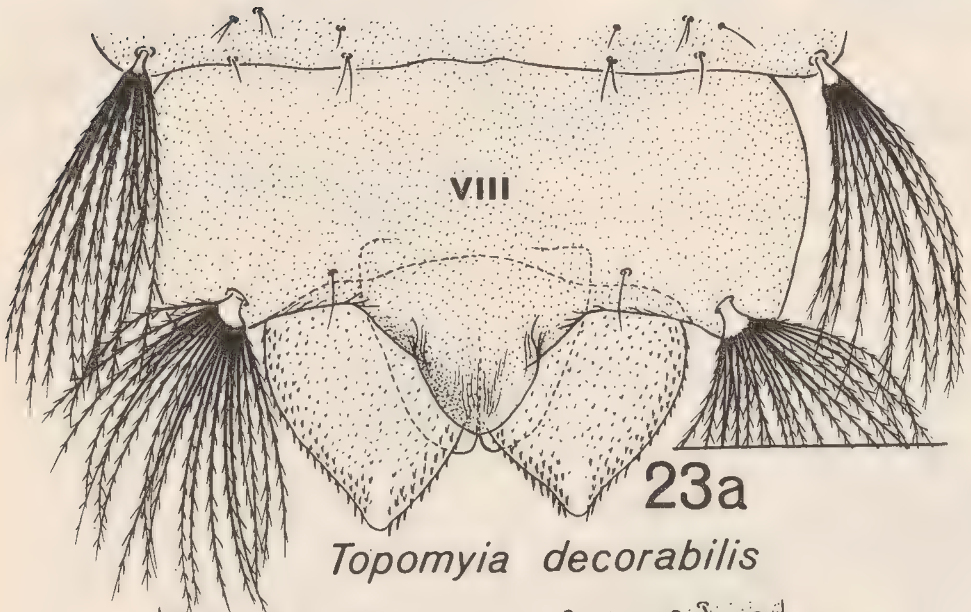
Topomyia spathulirostris

Pl.9

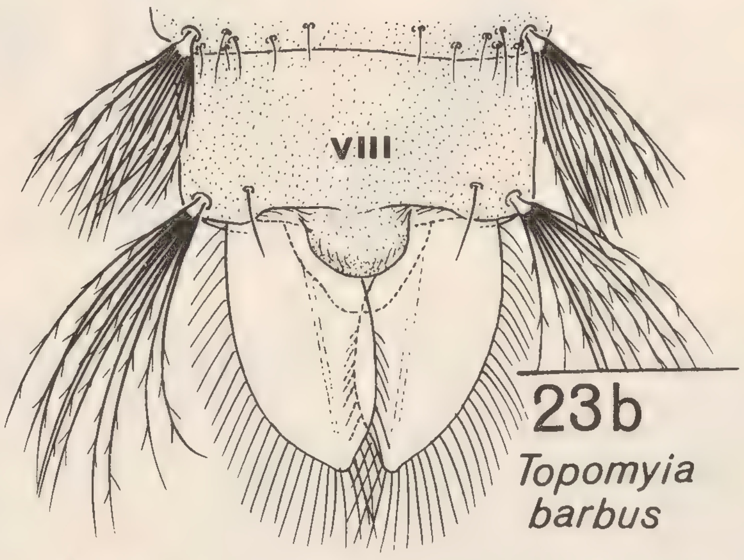

22e
Topomyia tipuliformis


22f
Tripteroides lorengaui

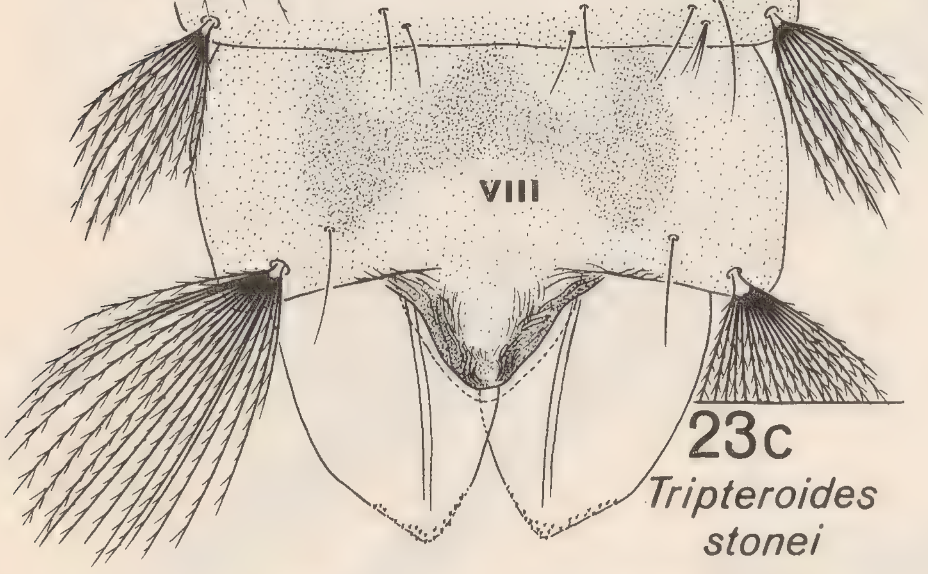

22g
Tripteroides fuscipleura



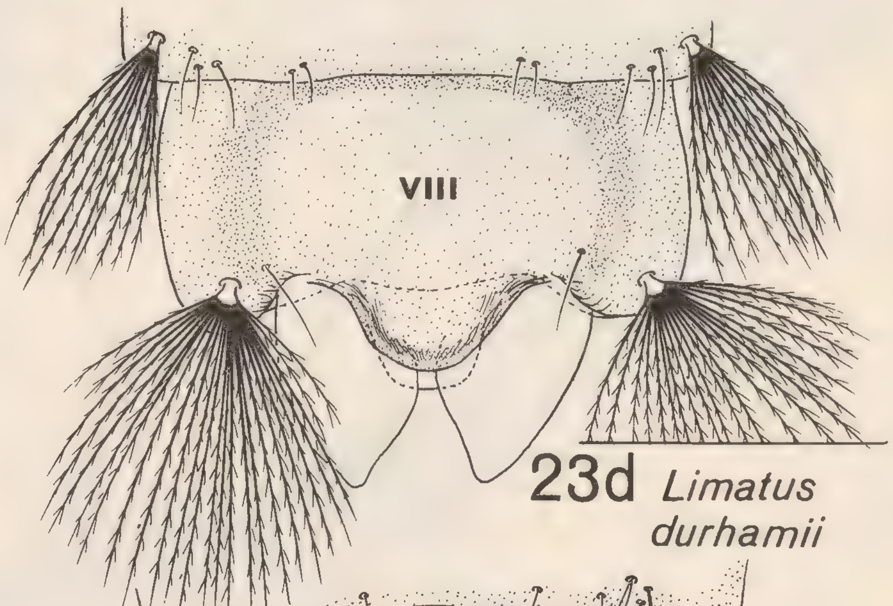
23a
Topomyia decorabilis



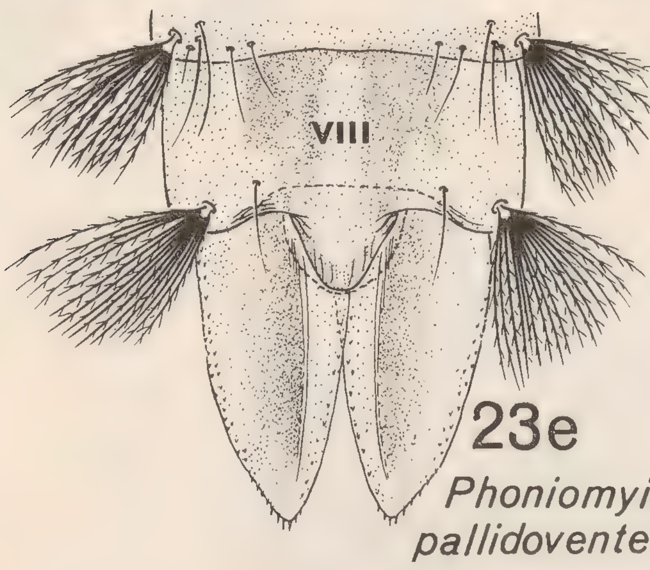
23b
Topomyia barbus



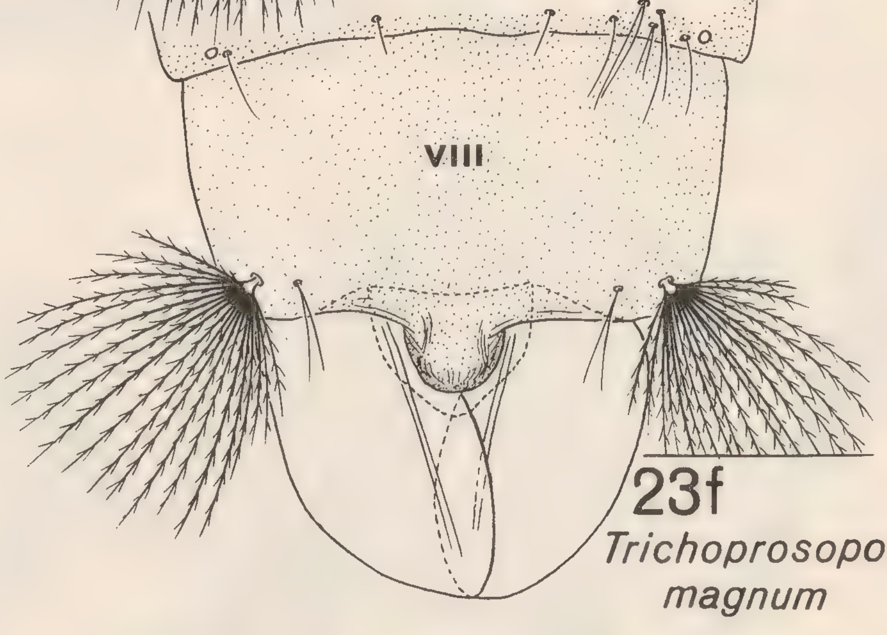
23c
Tripteroides stonei



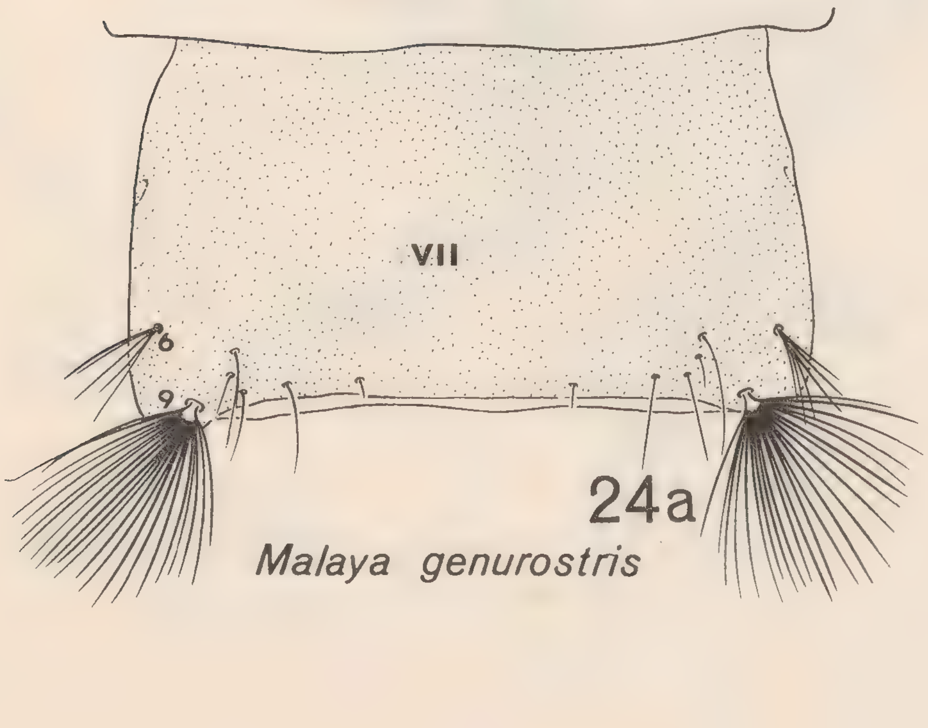
23d
Limatus durhamii



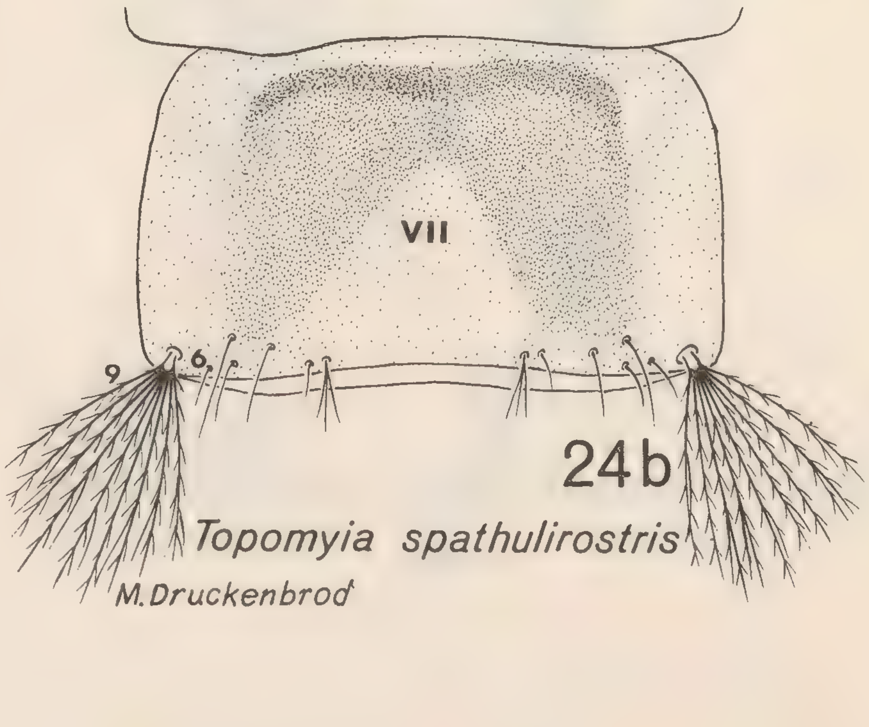
23e
Phoniomyia pallidoventer



23f
Trichoprosopon magnum



24a
Malaya genurostris



24b
Topomyia spathulirostris

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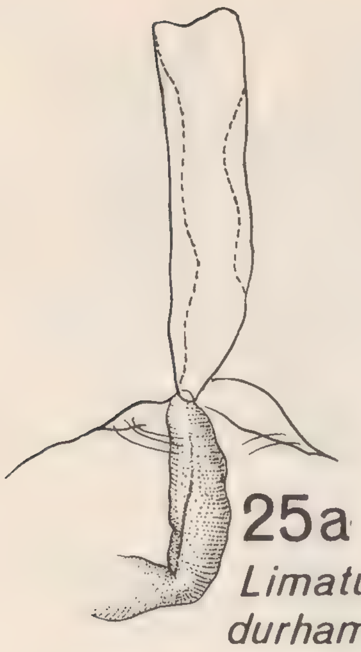
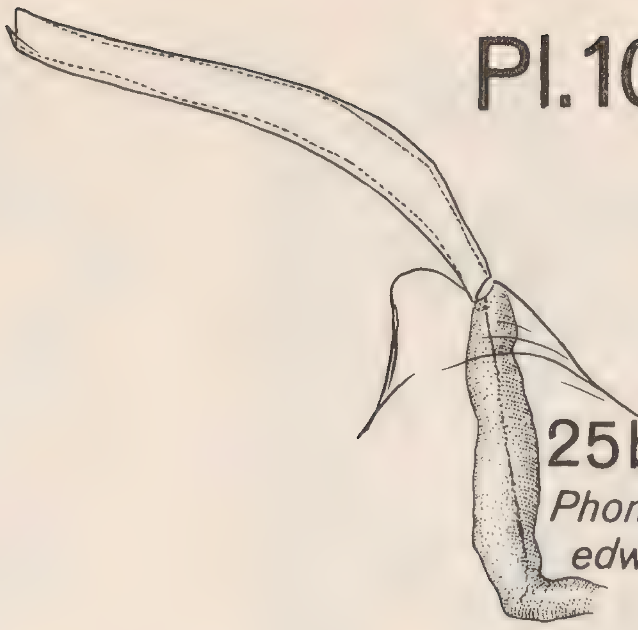
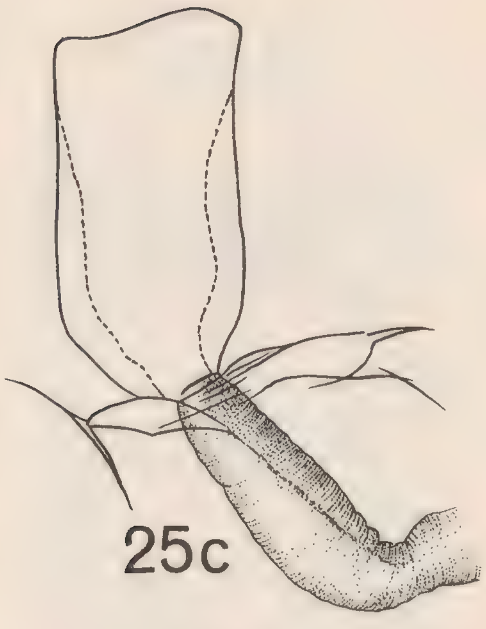
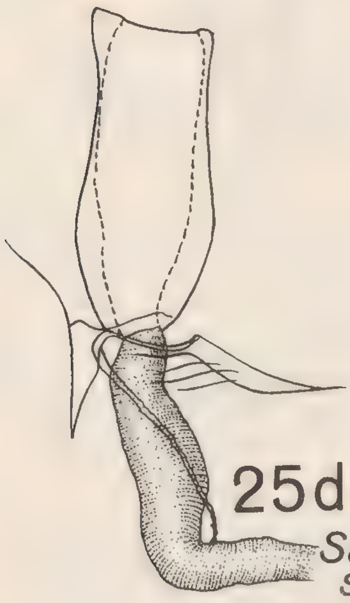
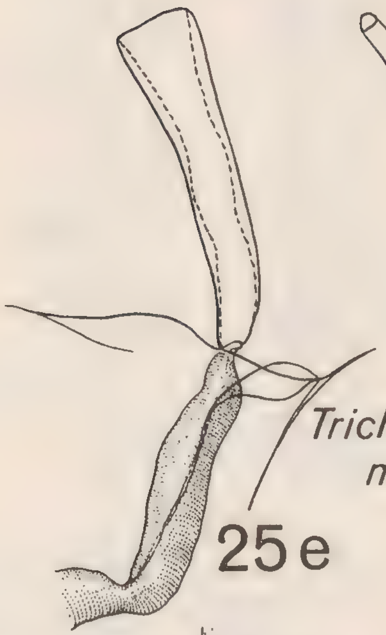
Pl. 10

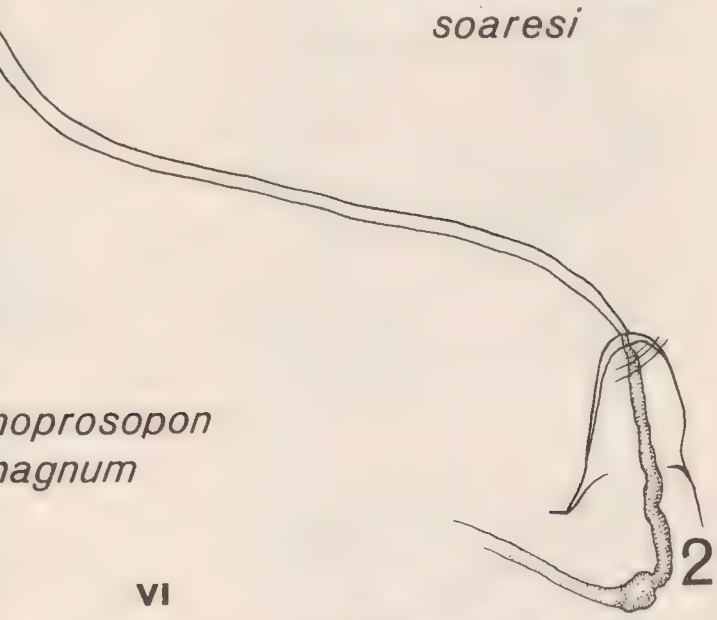

25a *Limatus durhamii*

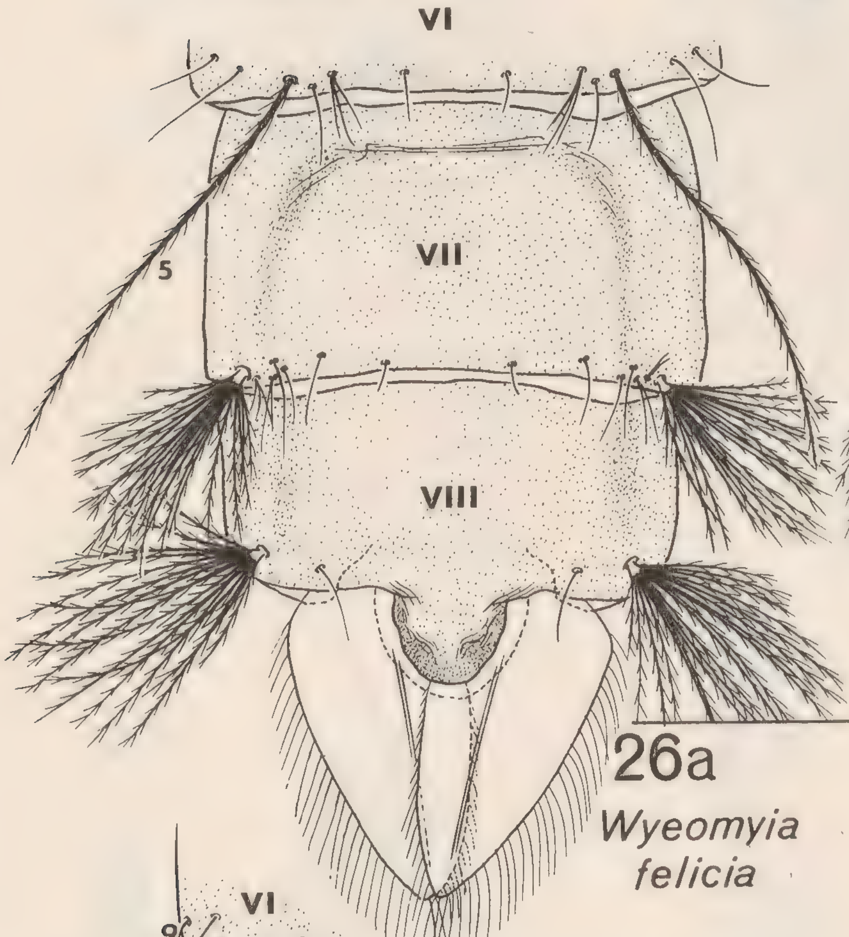

25b *Phoniomyia edwardsi*


25c *Trichoprosopon soaresi*

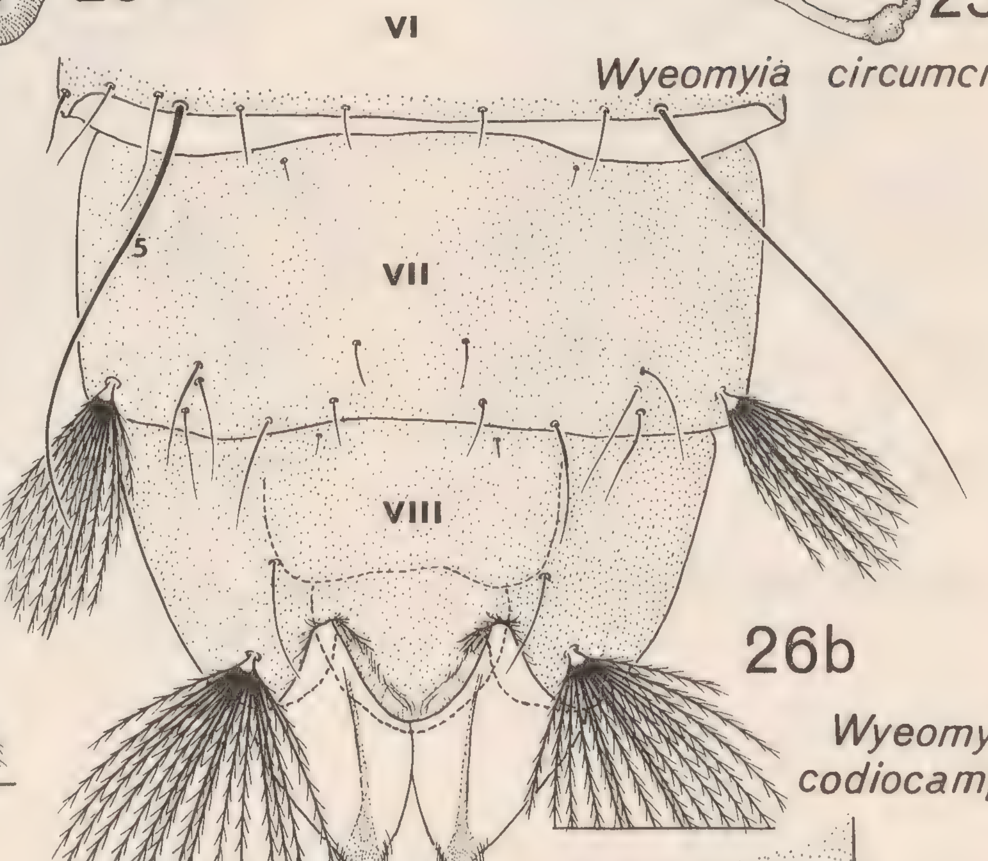

25d *Sabethes soperi*


25e *Trichoprosopon magnum*

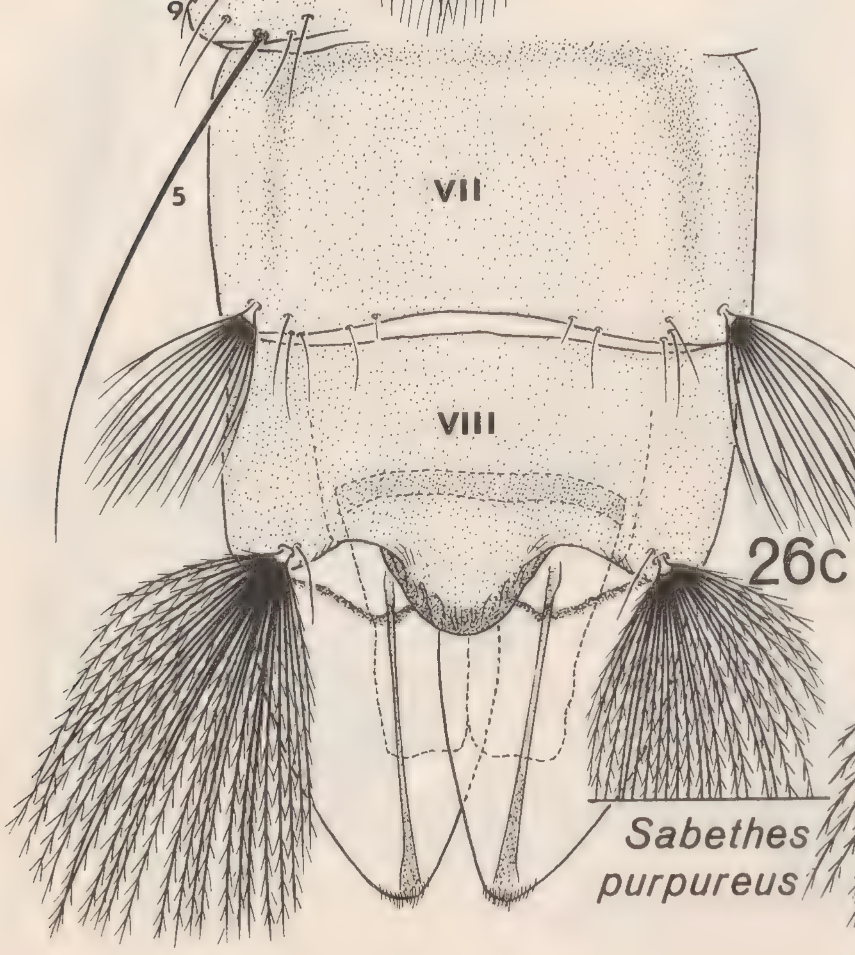

25f *Wyeomyia circumcincta*



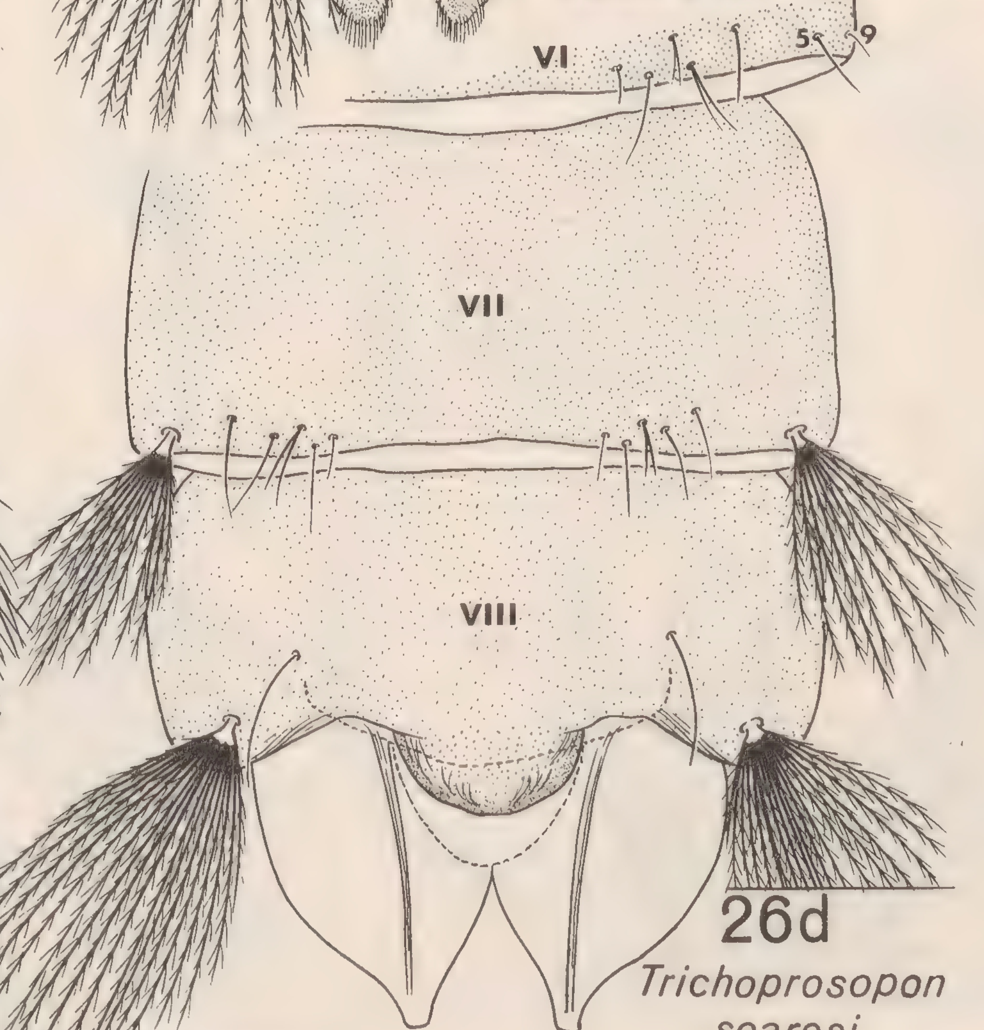
26a *Wyeomyia felicia*



26b *Wyeomyia codiocampa*



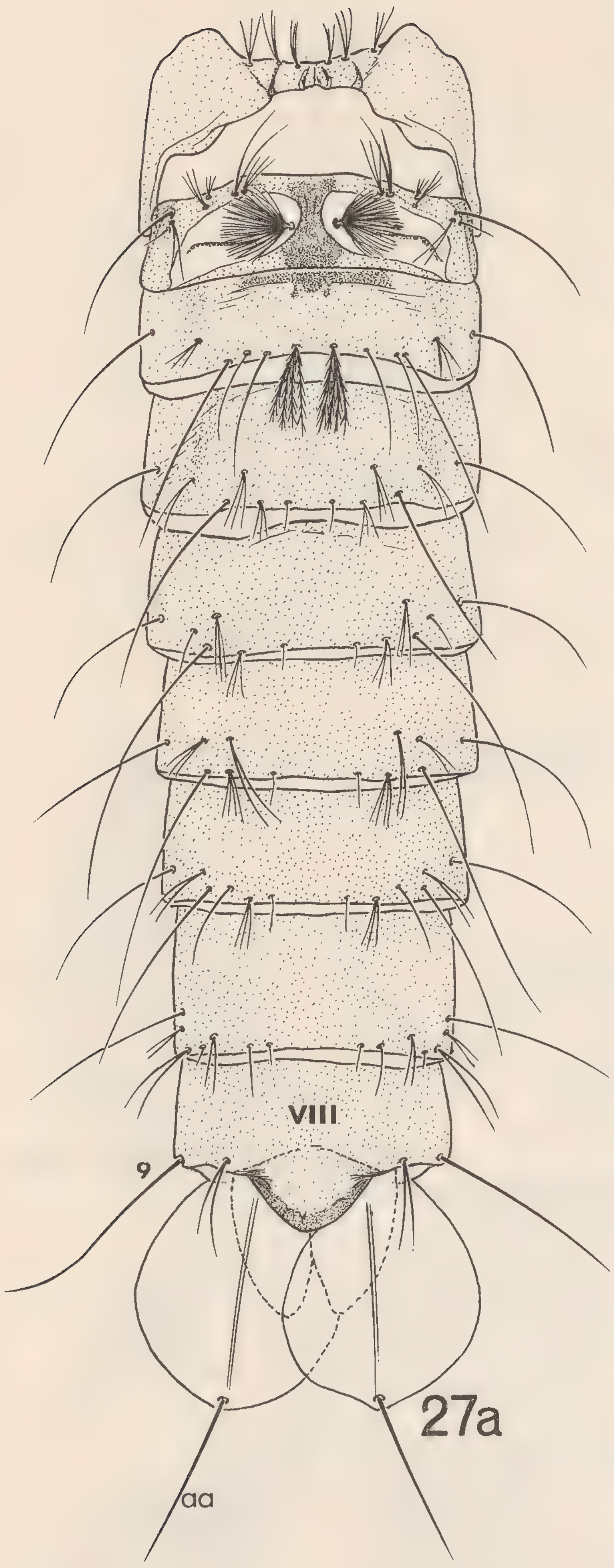
26c *Sabethes purpureus*



26d *Trichoprosopon soaresi*

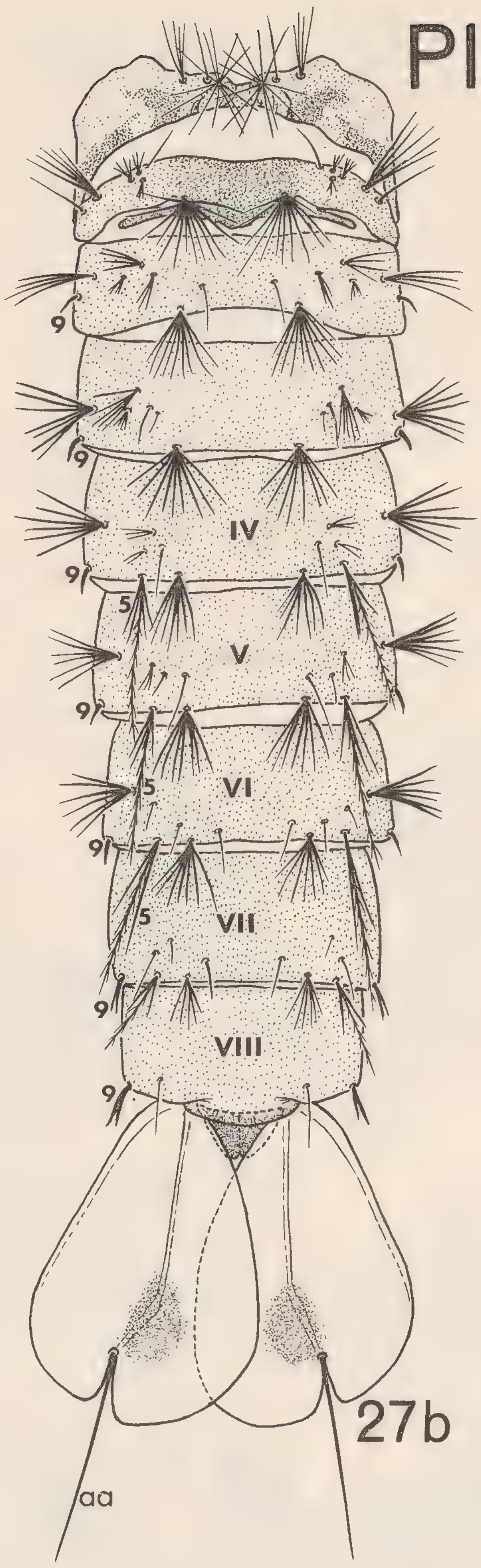
M. Druckenbrod

Pl.11



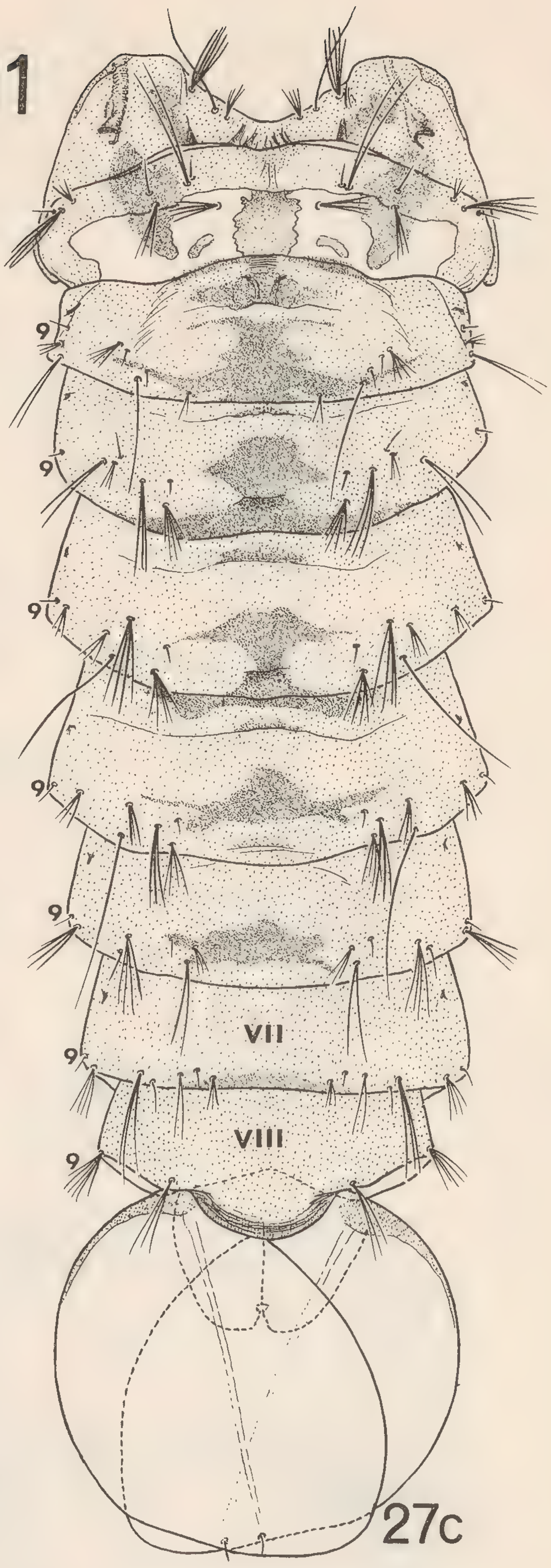
27a

Deinocerites mcdonaldi



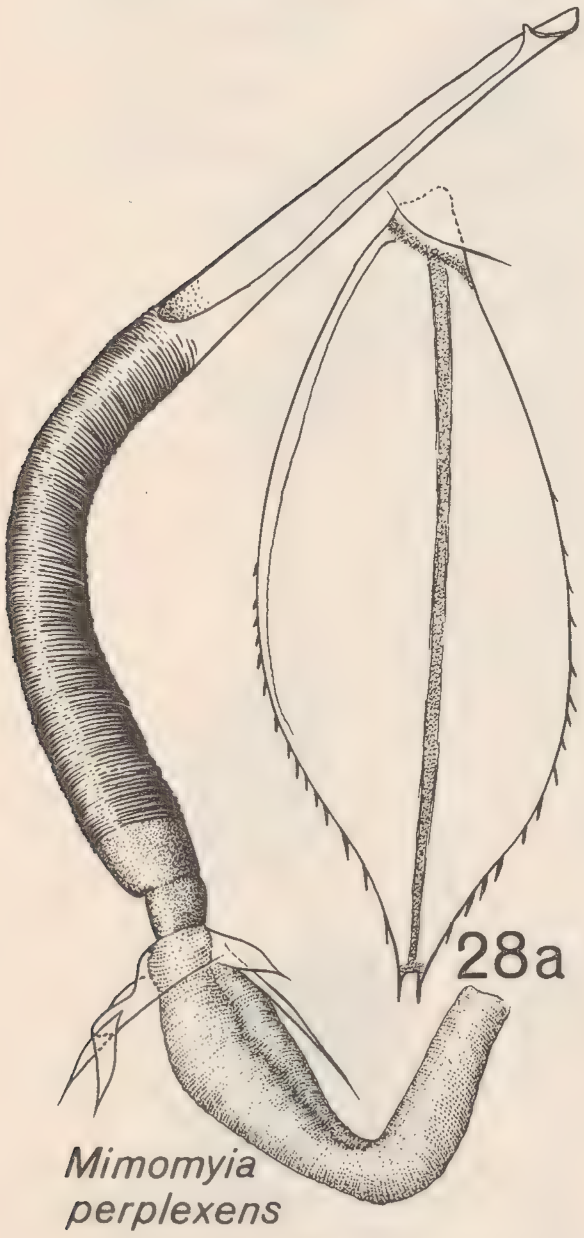
27b

Aedeomyia catasticta



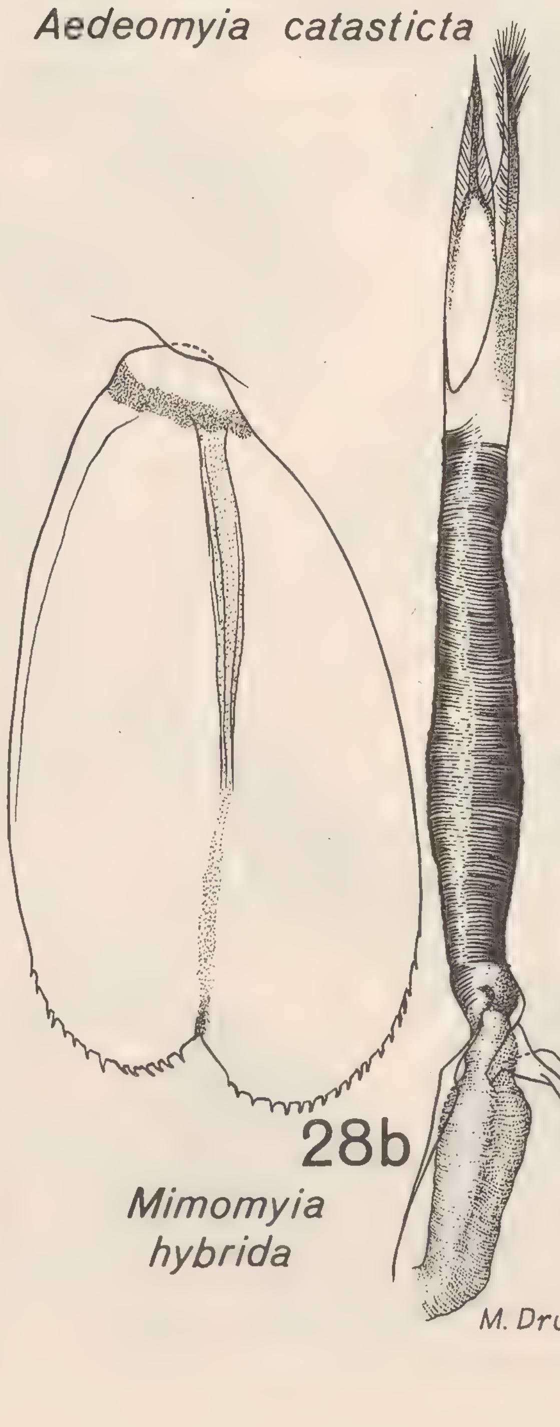
27c

Opifex fuscus



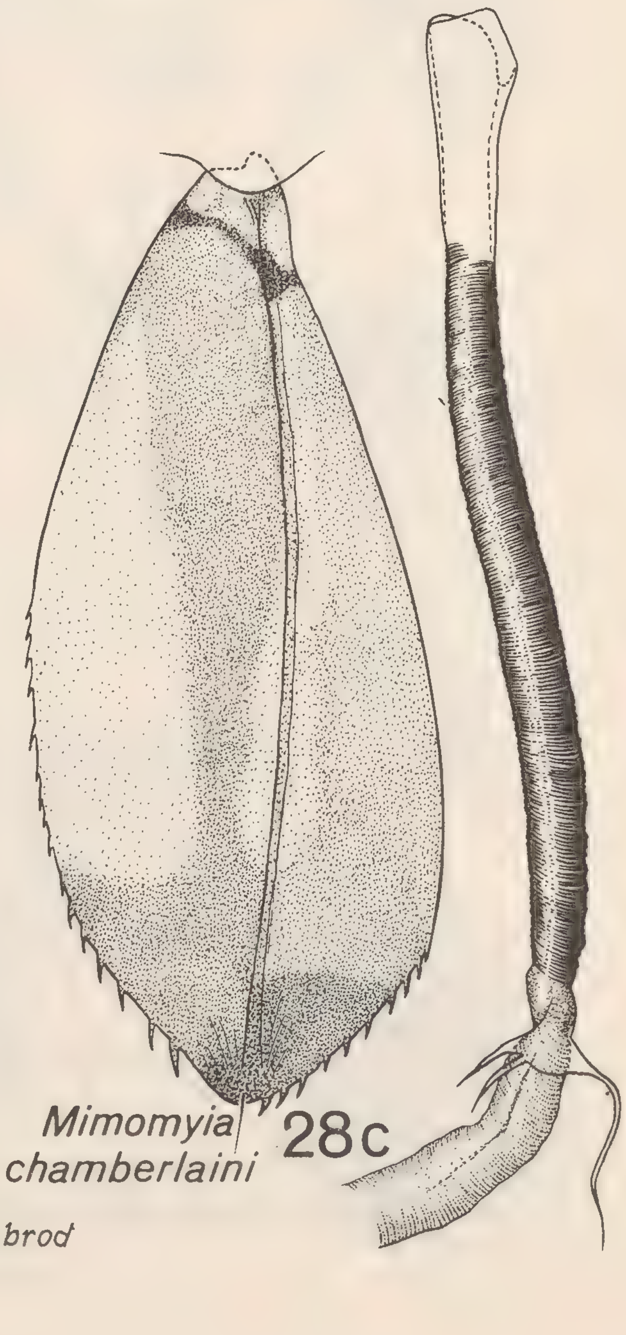
28a

Mimomyia perplexens



28b

Mimomyia hybrida

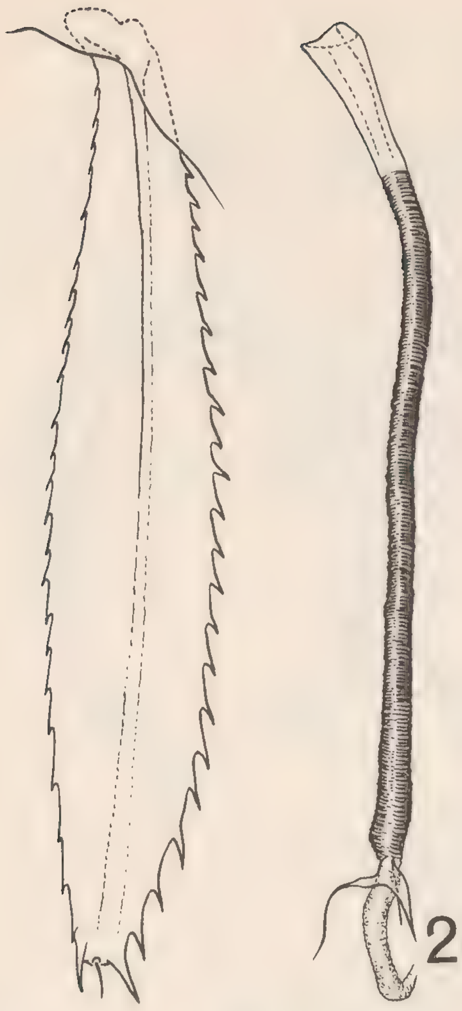


28c

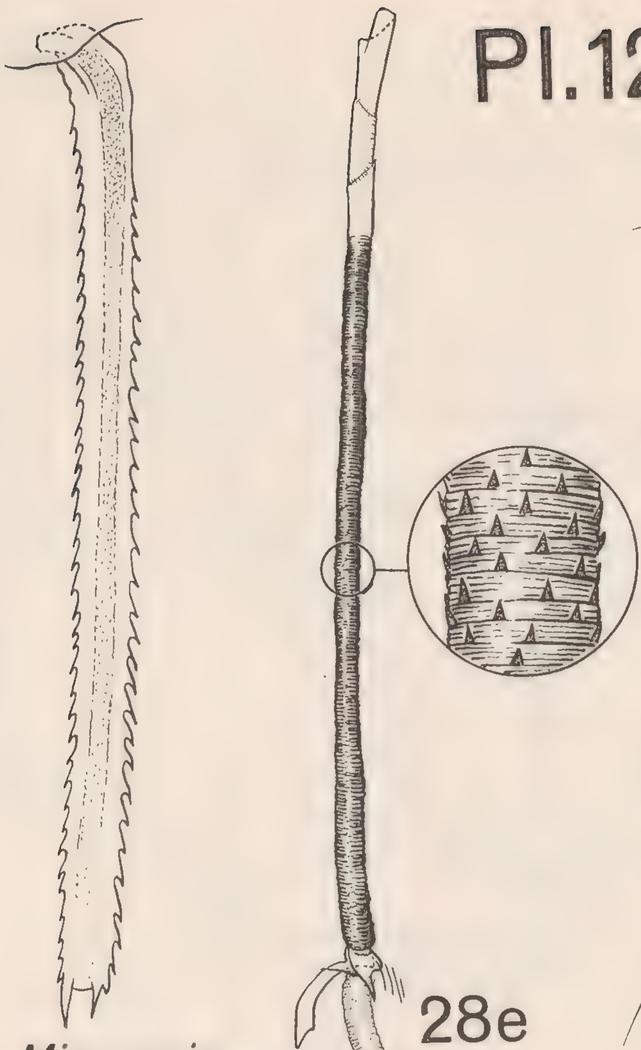
Mimomyia chamberlaini

M. Druckenbrod

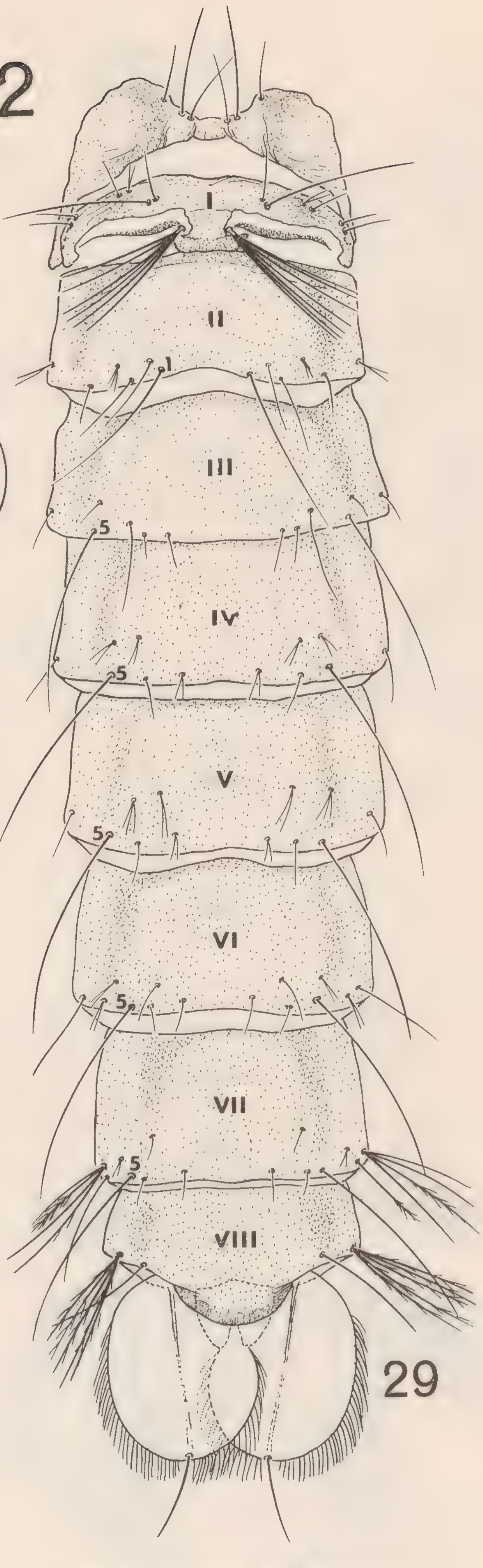
Pl.12


28d

Mimomyia (Etorleptiomyia) luzonensis

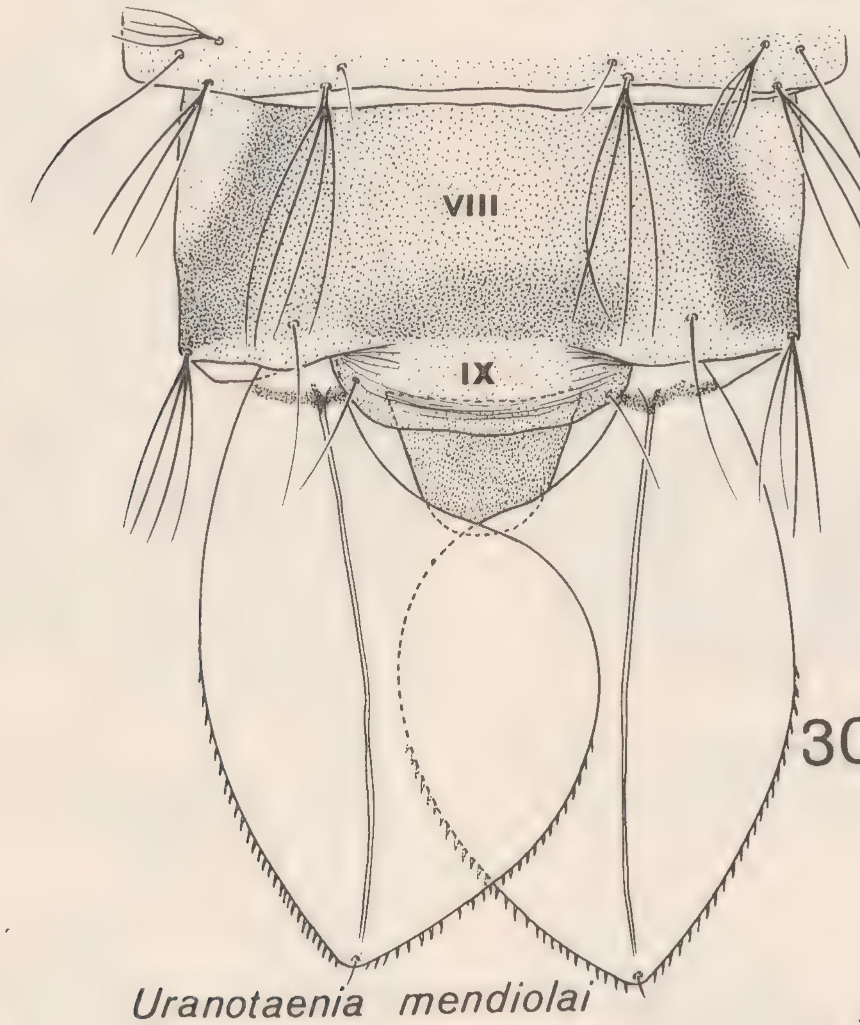

28e

Mimomyia (Ravenalites) deguzmanae



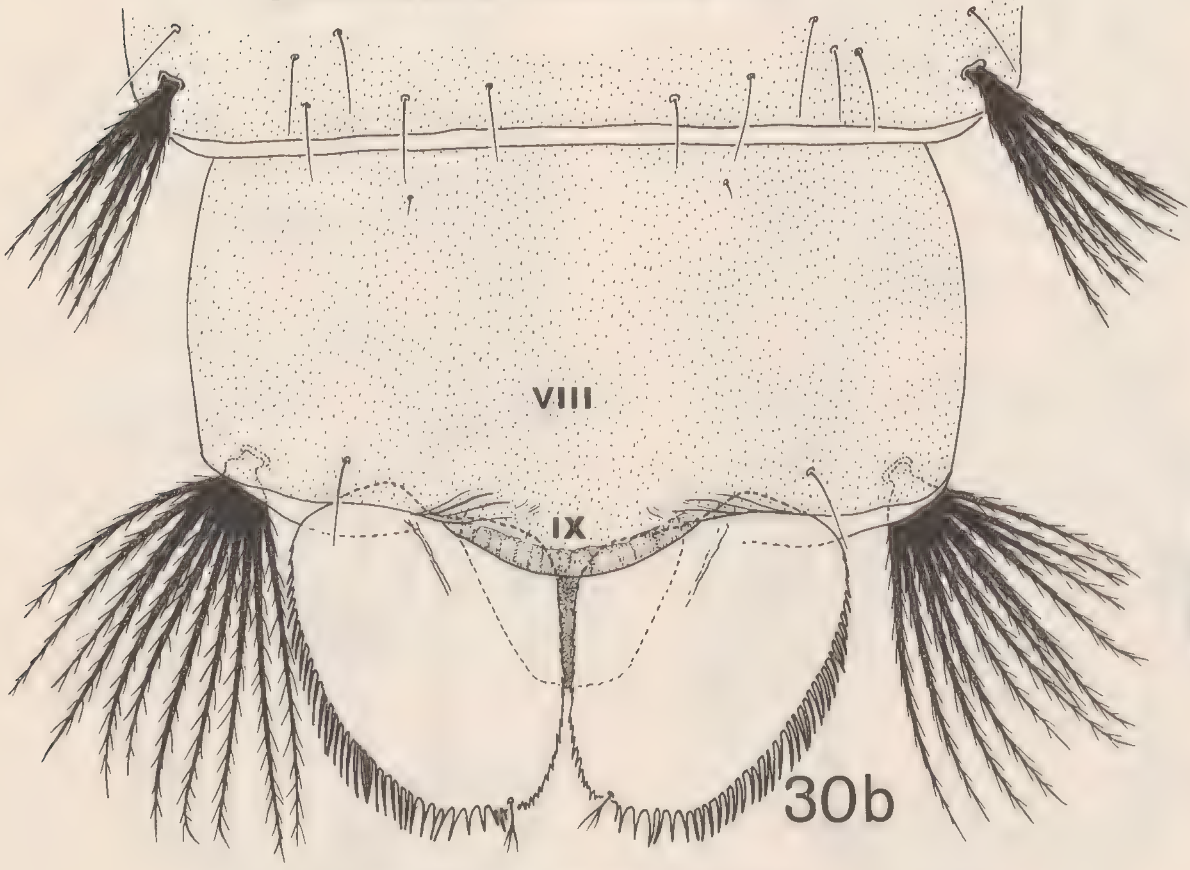
29

Zeugnomyia lawtoni



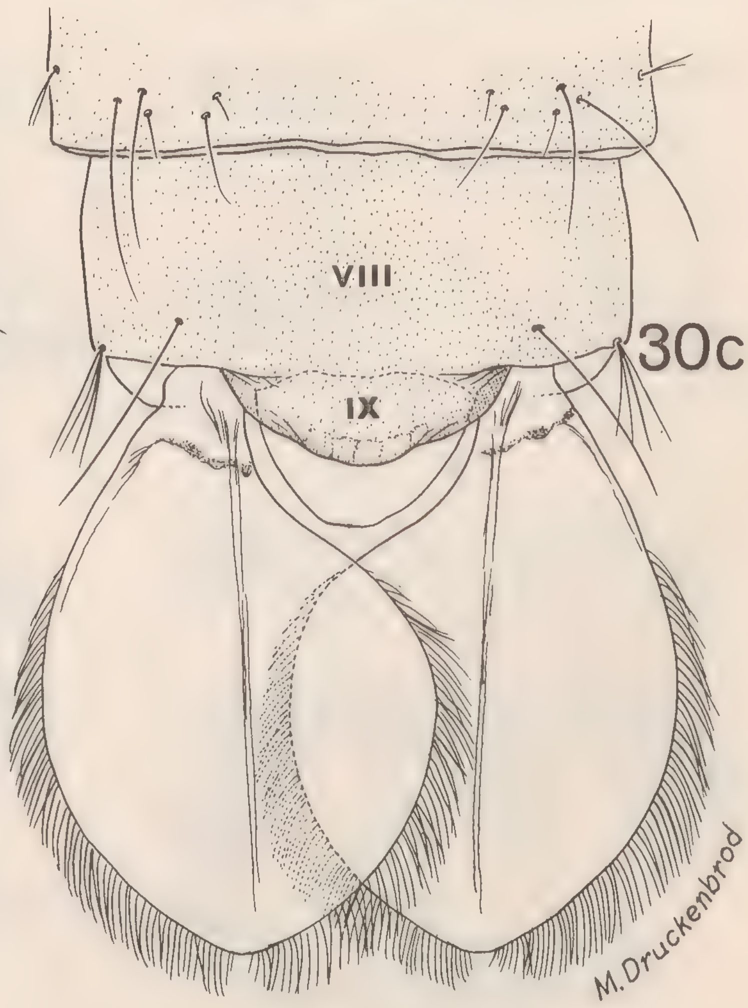
30a

Uranotaenia mendiolai



30b

Uranotaenia ascidiicola

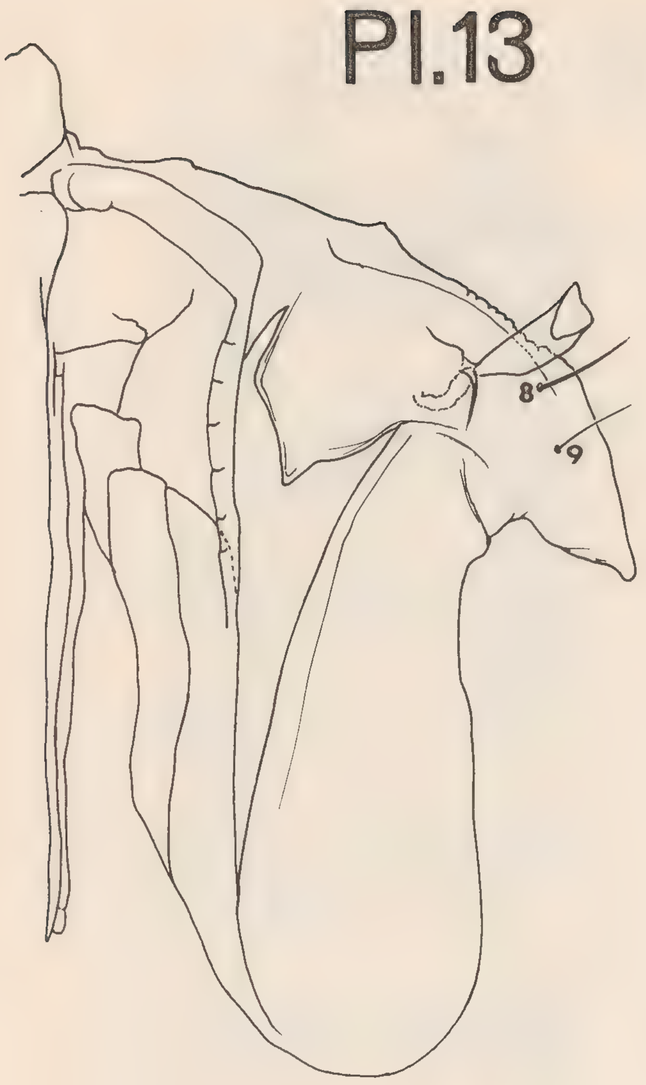


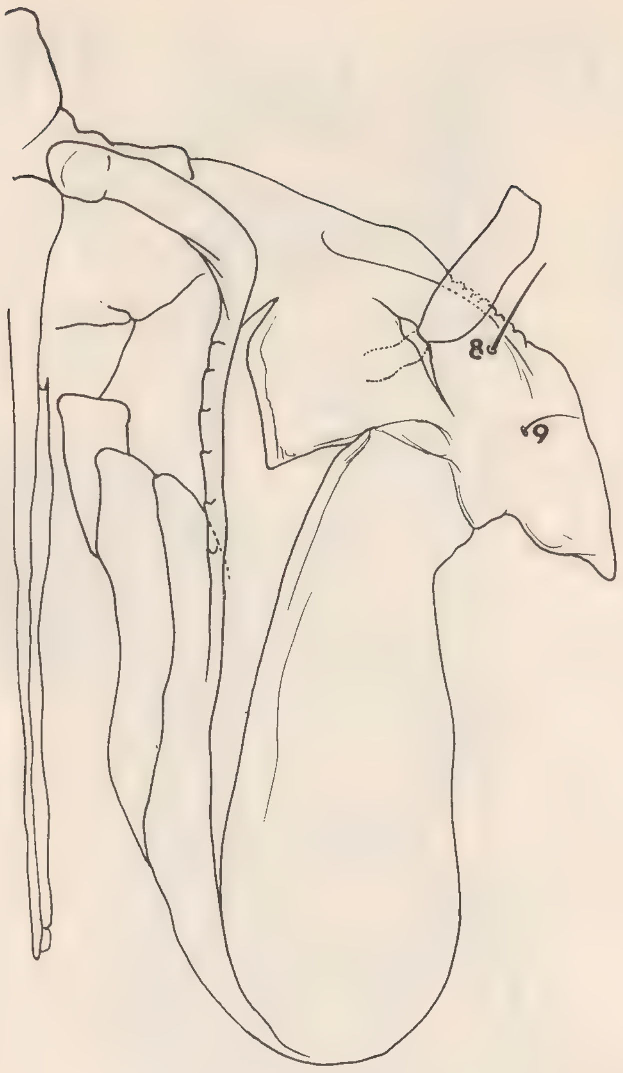
30c

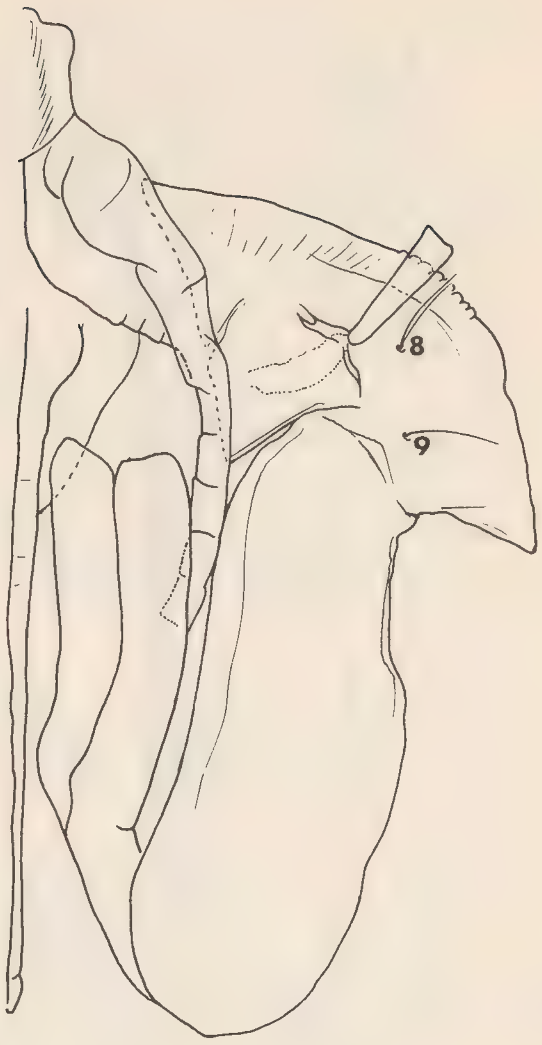
M.Druckenbrod

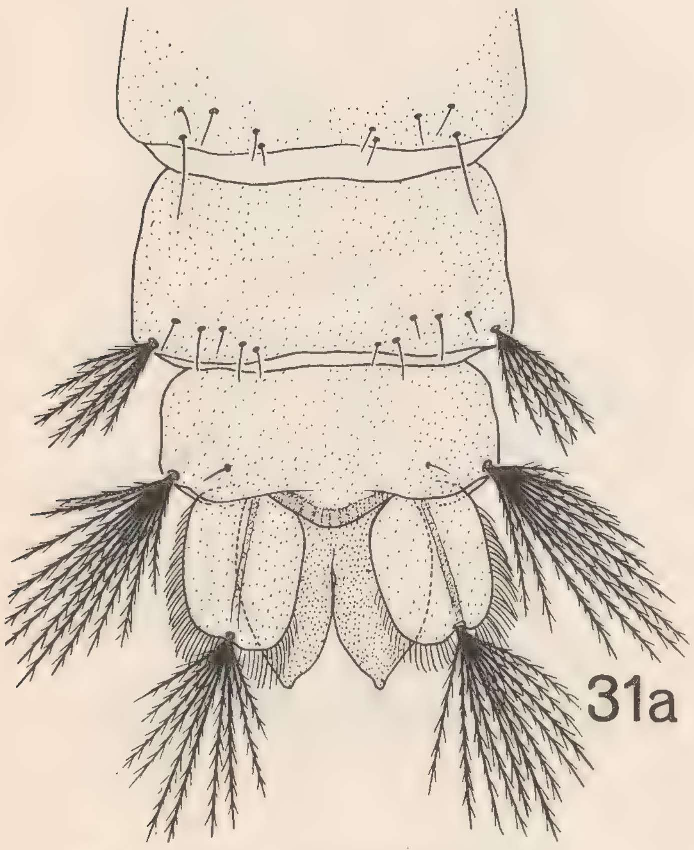
Uranotaenia modesta

Pl.13

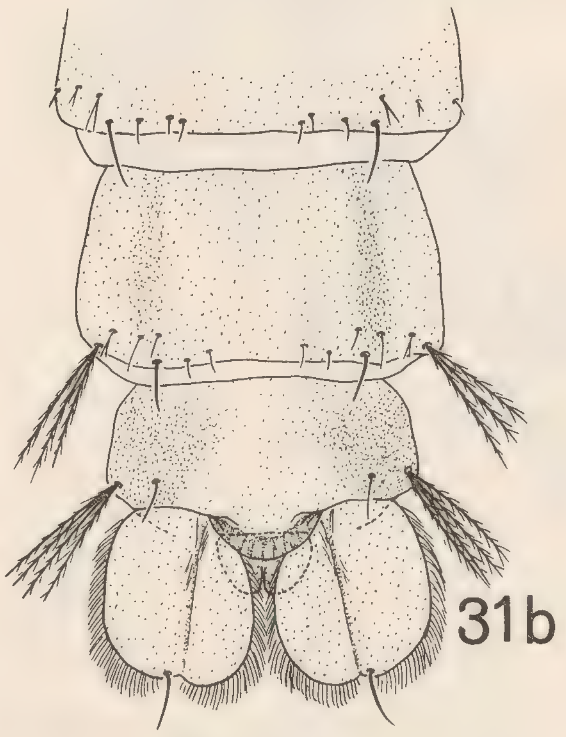




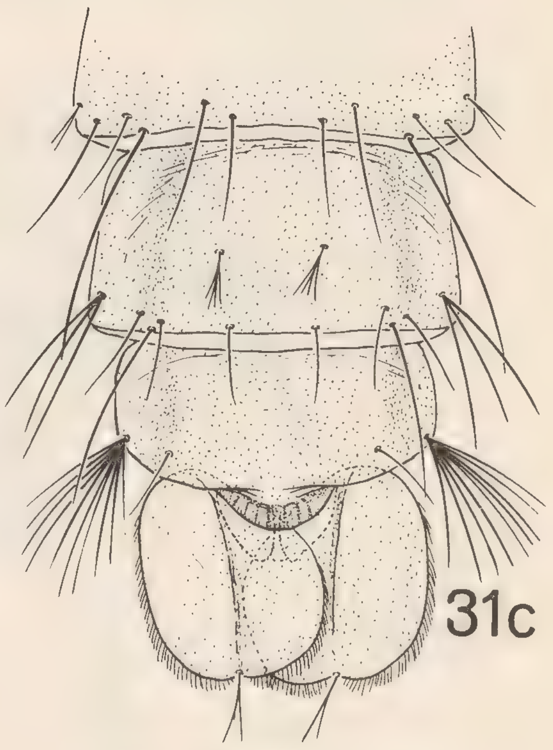




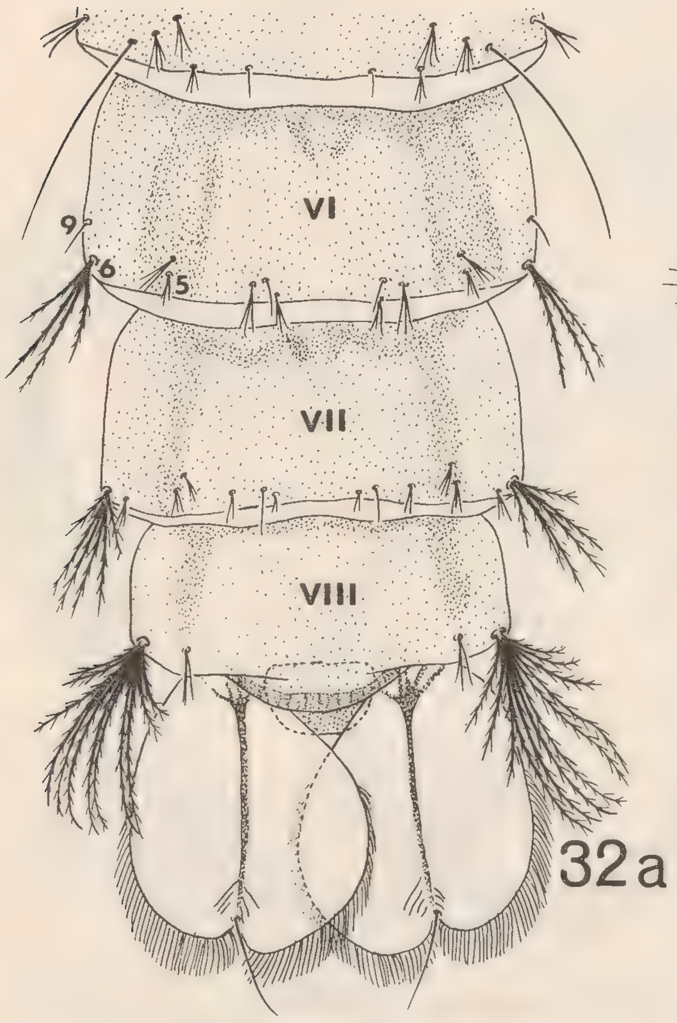
Eretmapodites inornatus



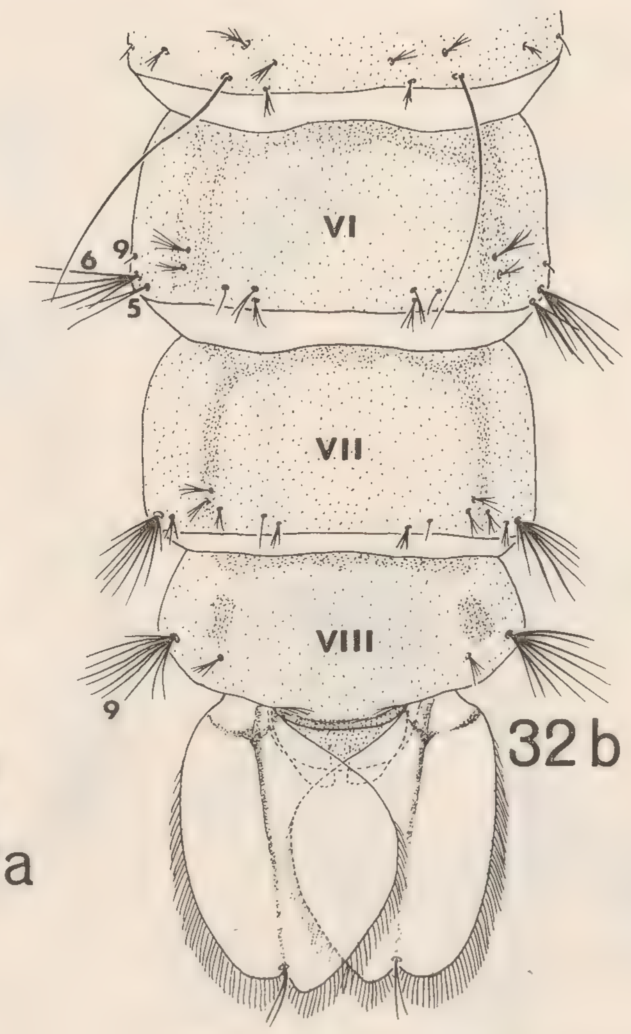
Eretmapodites dracaenae



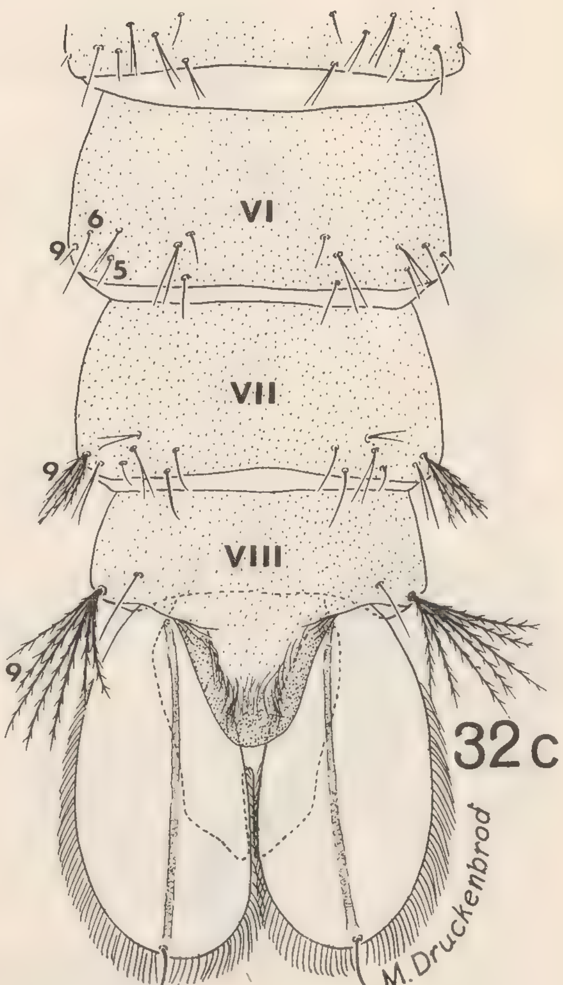
Aedes (Stegomyia) ruwenzori



Armigeres subalbatus

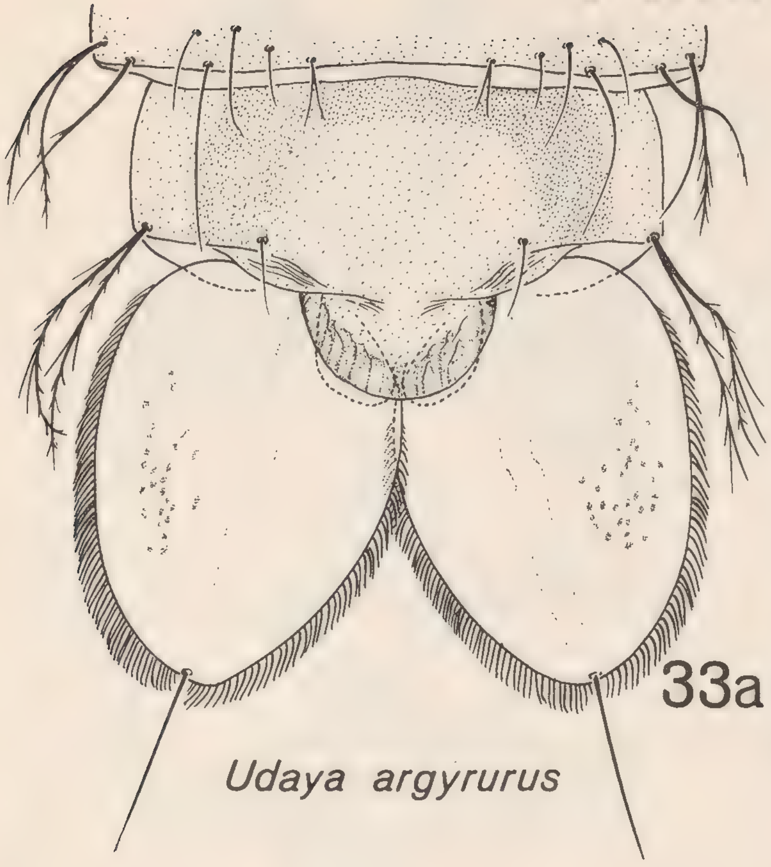


Armigeres malayi



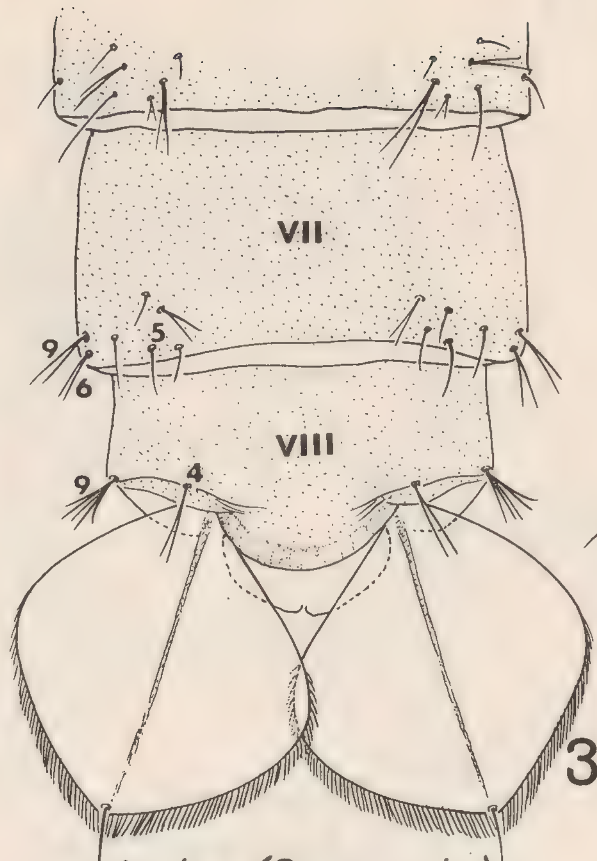
Heizmannia achaetae

Pl.14



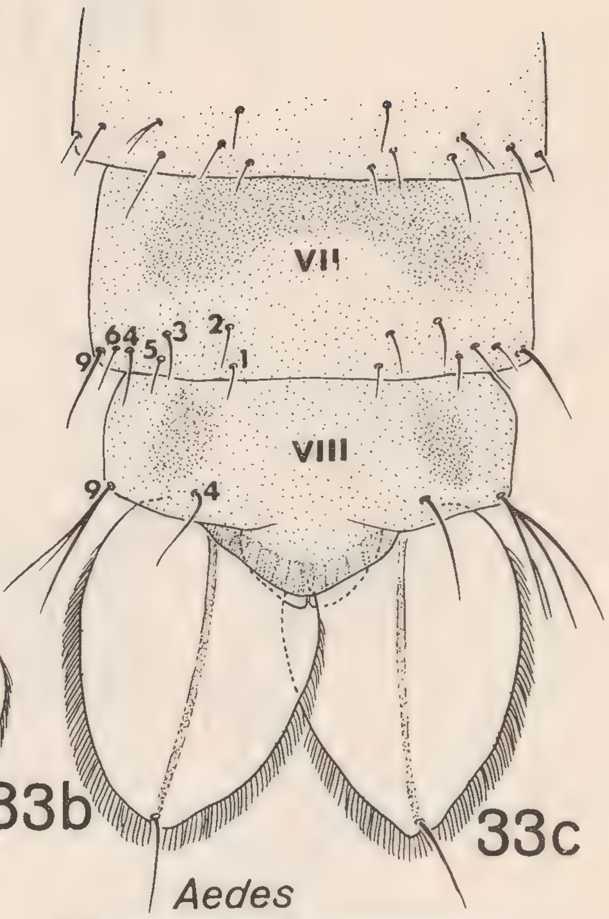
33a

Udaya argyrurus



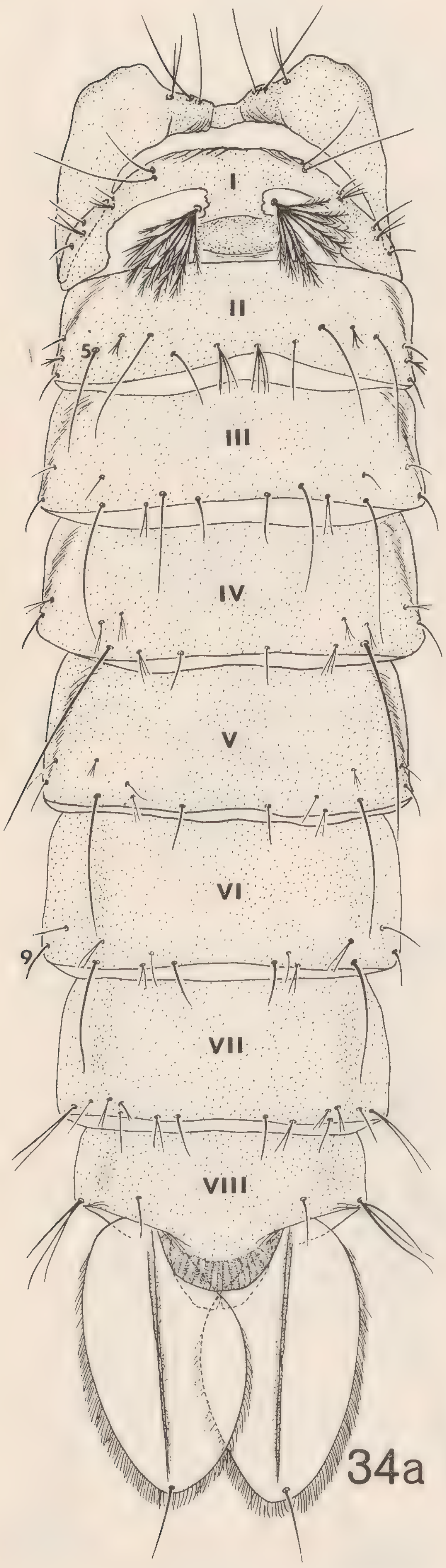
33b

Aedes (Stegomyia) meronephada



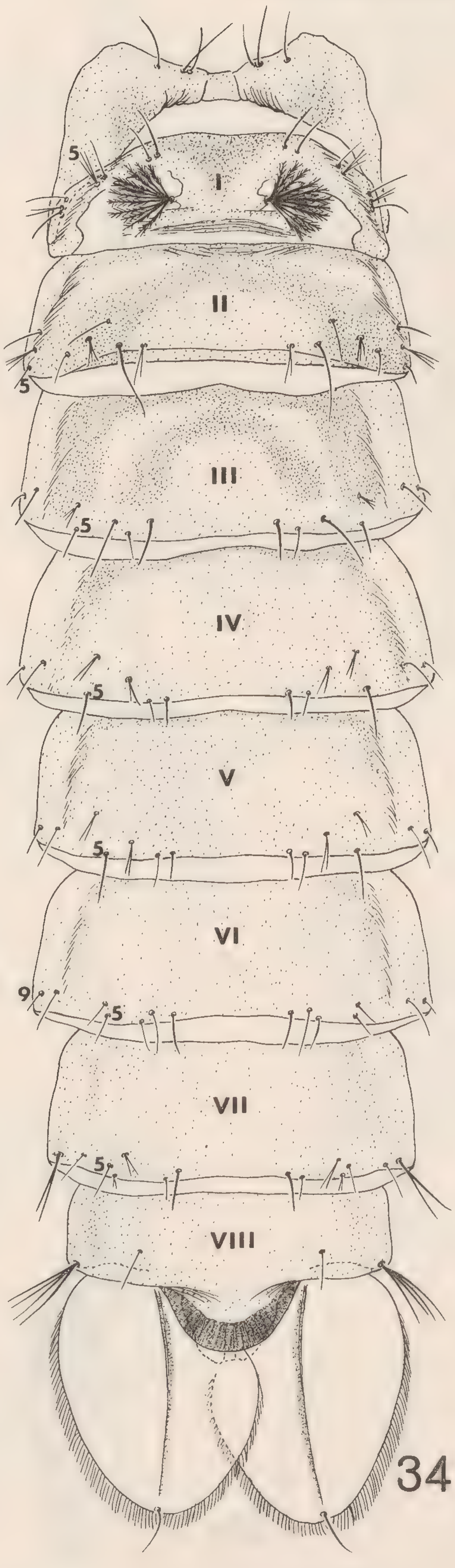
33c

Aedes (Stegomyia) annandalei



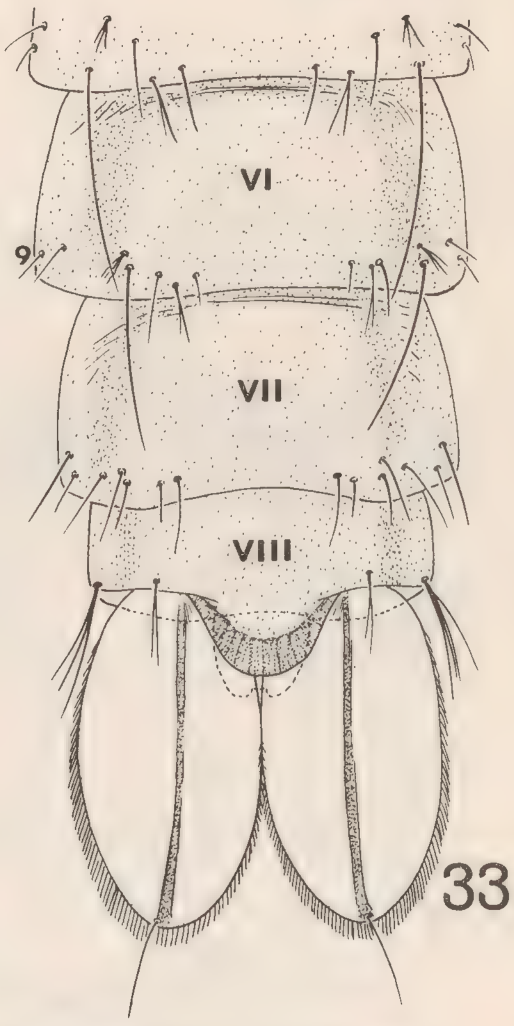
34a

Heizmannia complex



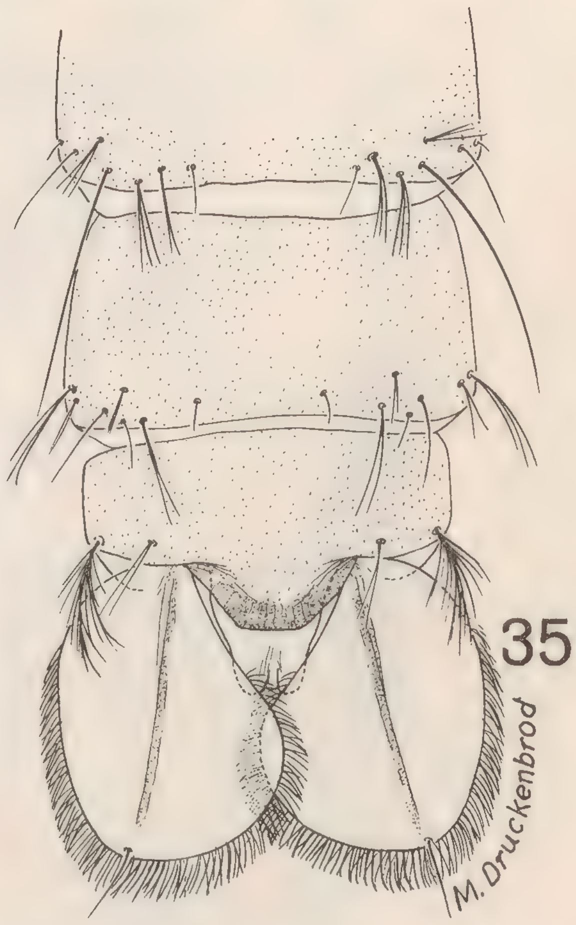
34b

Heizmannia aureochaeta



33d

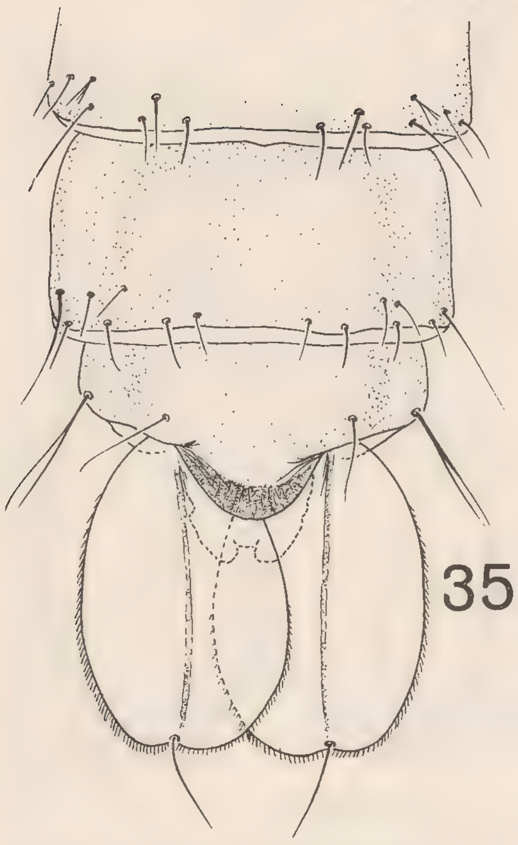
Heizmannia scintillans



35a

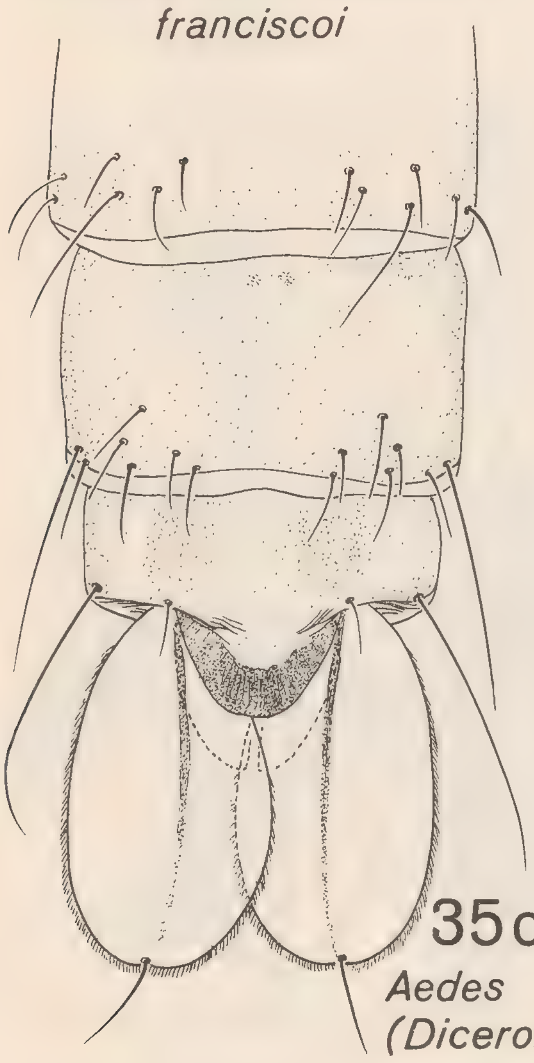
Aedes (Lorrainea) fumidus

Pl. 15



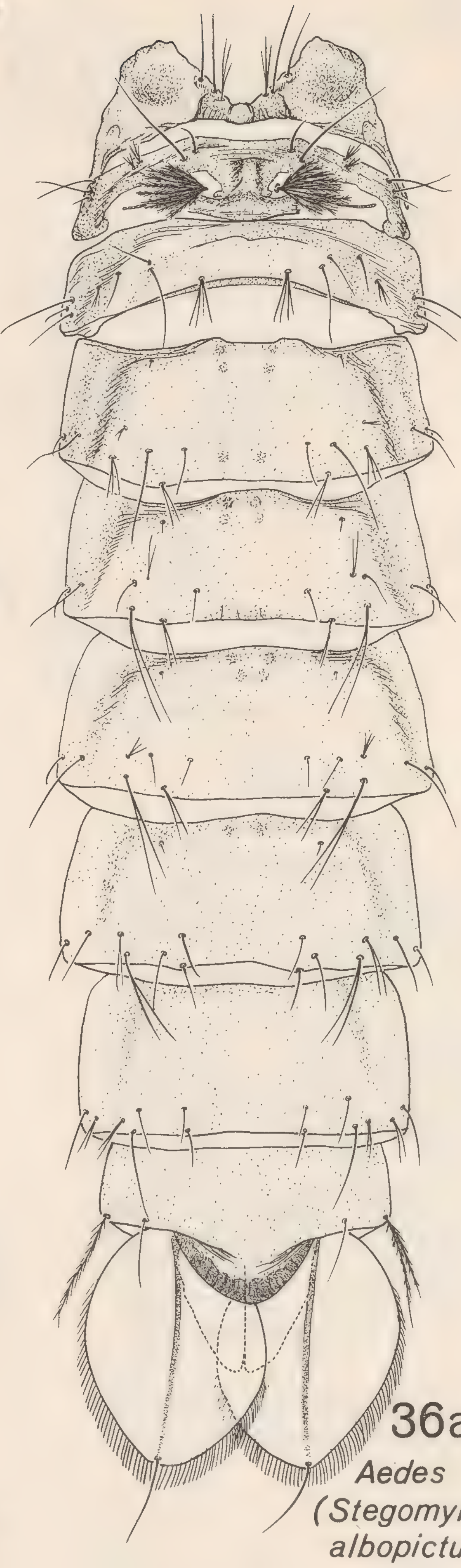
35b

Aedes (Diceromyia) franciscoi



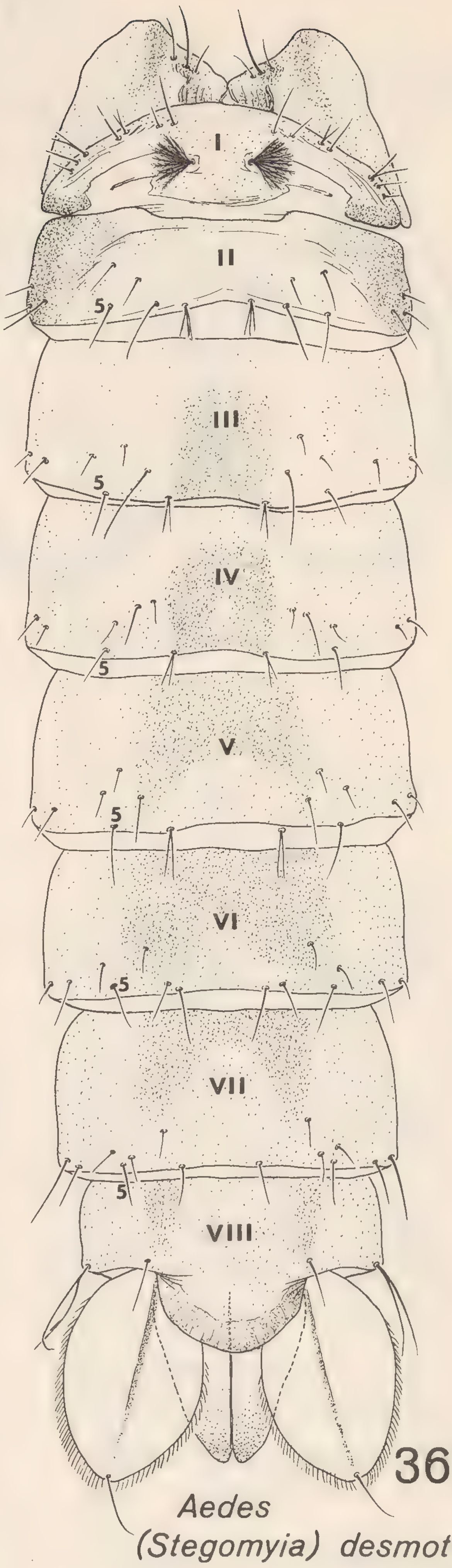
35c

Aedes (Diceromyia) periskelatus



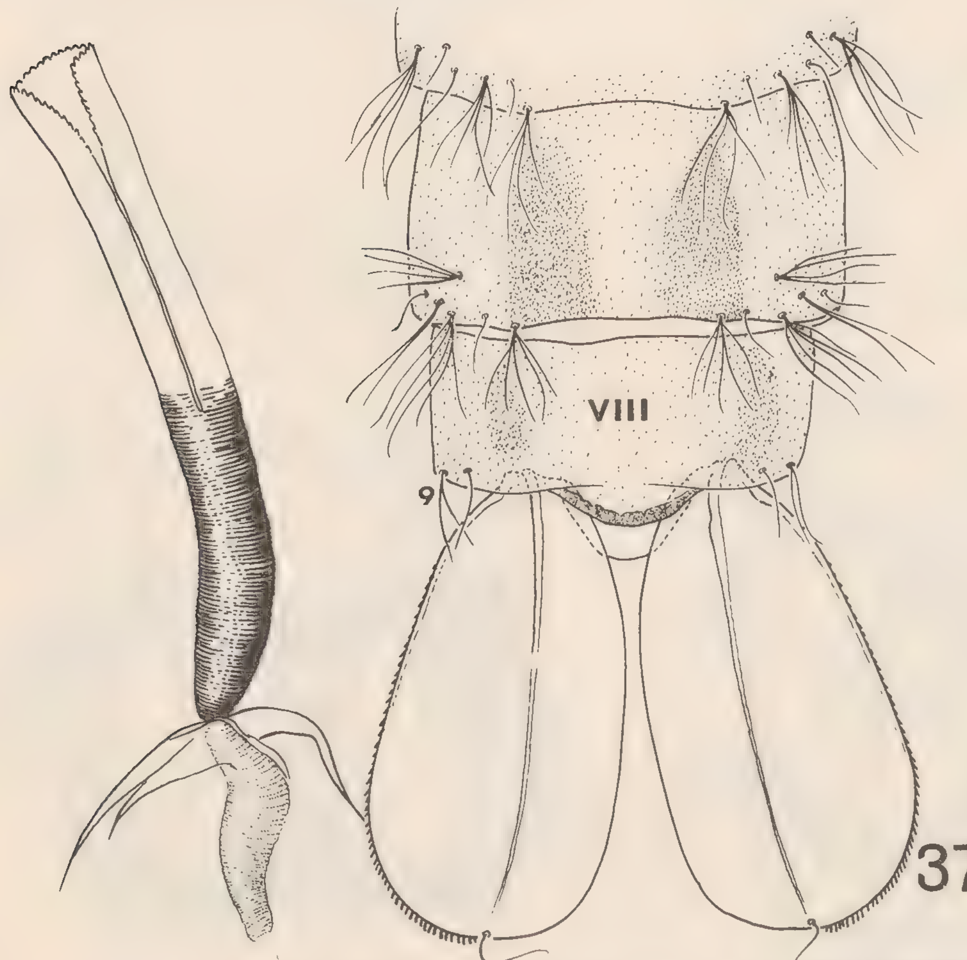
36a

Aedes (Stegomyia) albopictus



36b

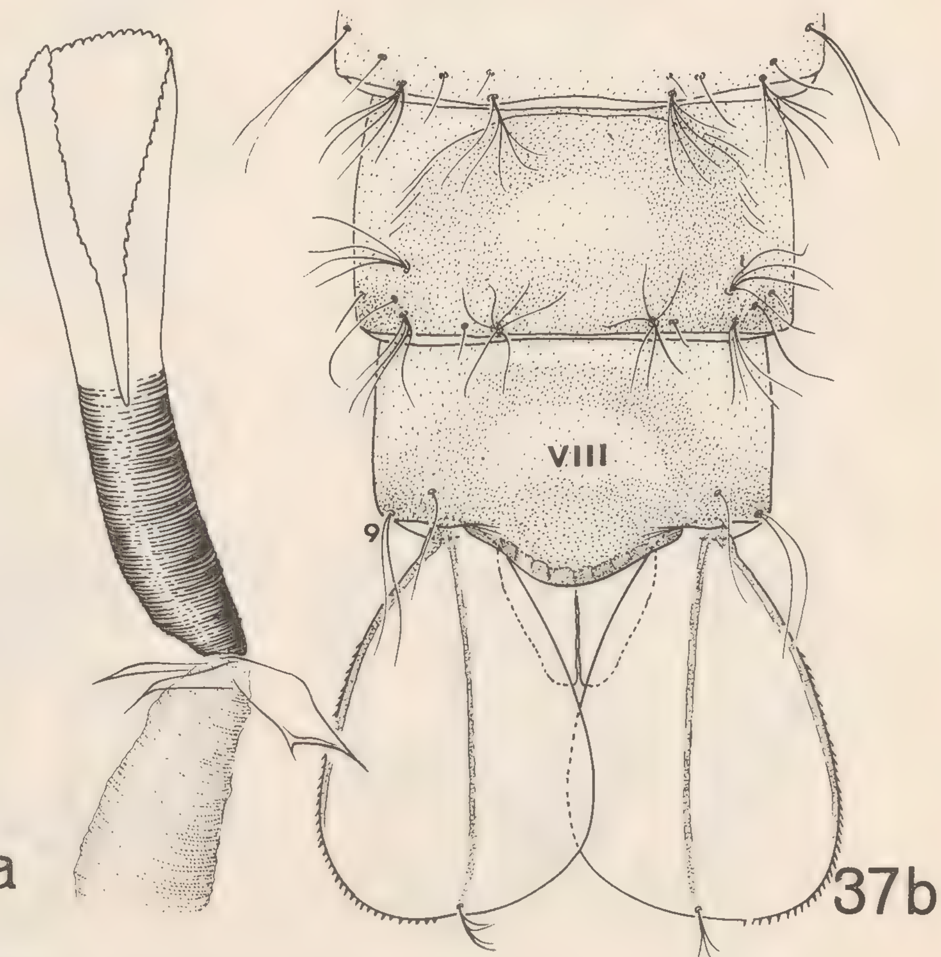
Aedes (Stegomyia) desmotes



37a

Ficalbia circumtestacea

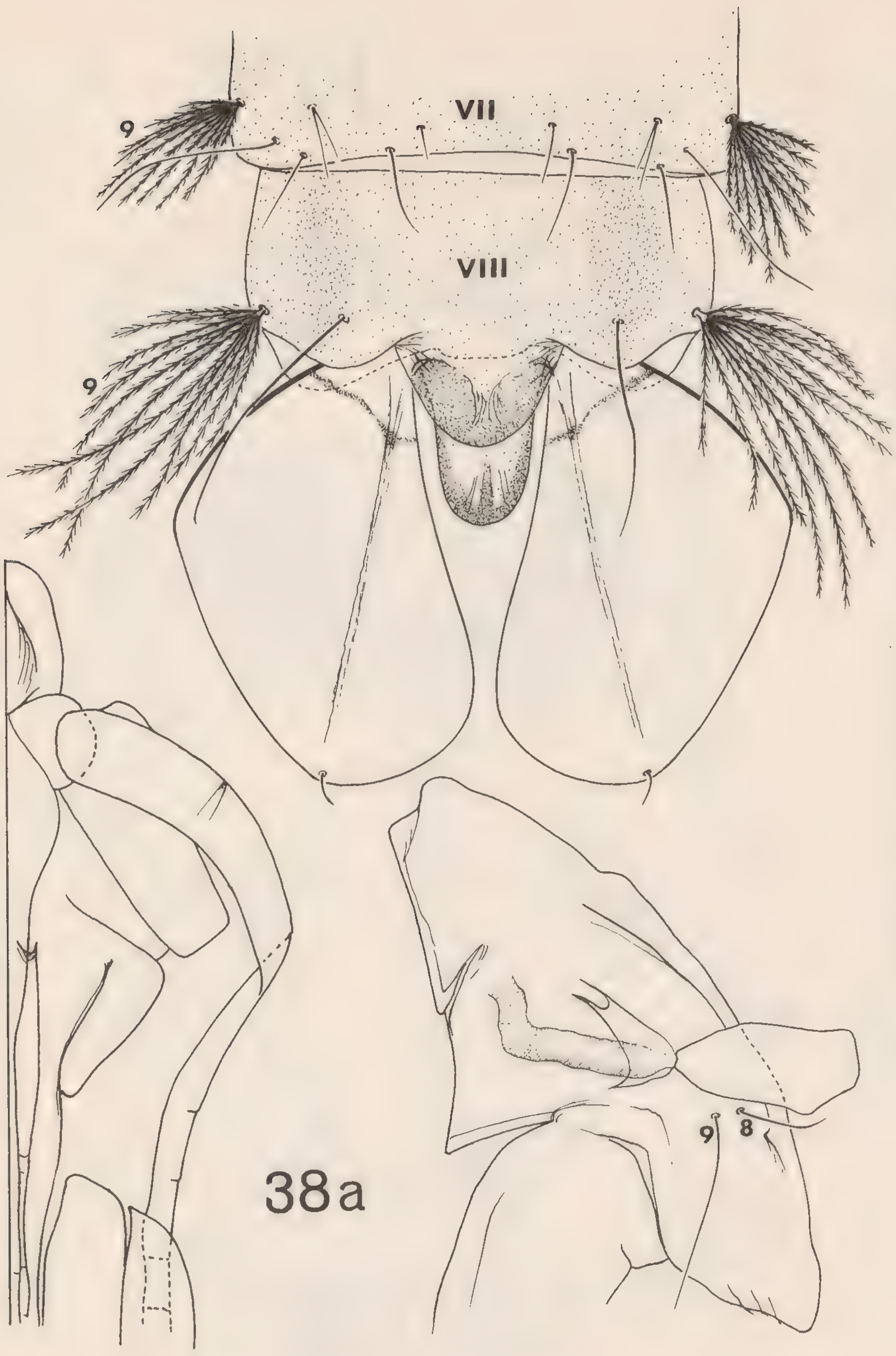
M. Druckenbrod



37b

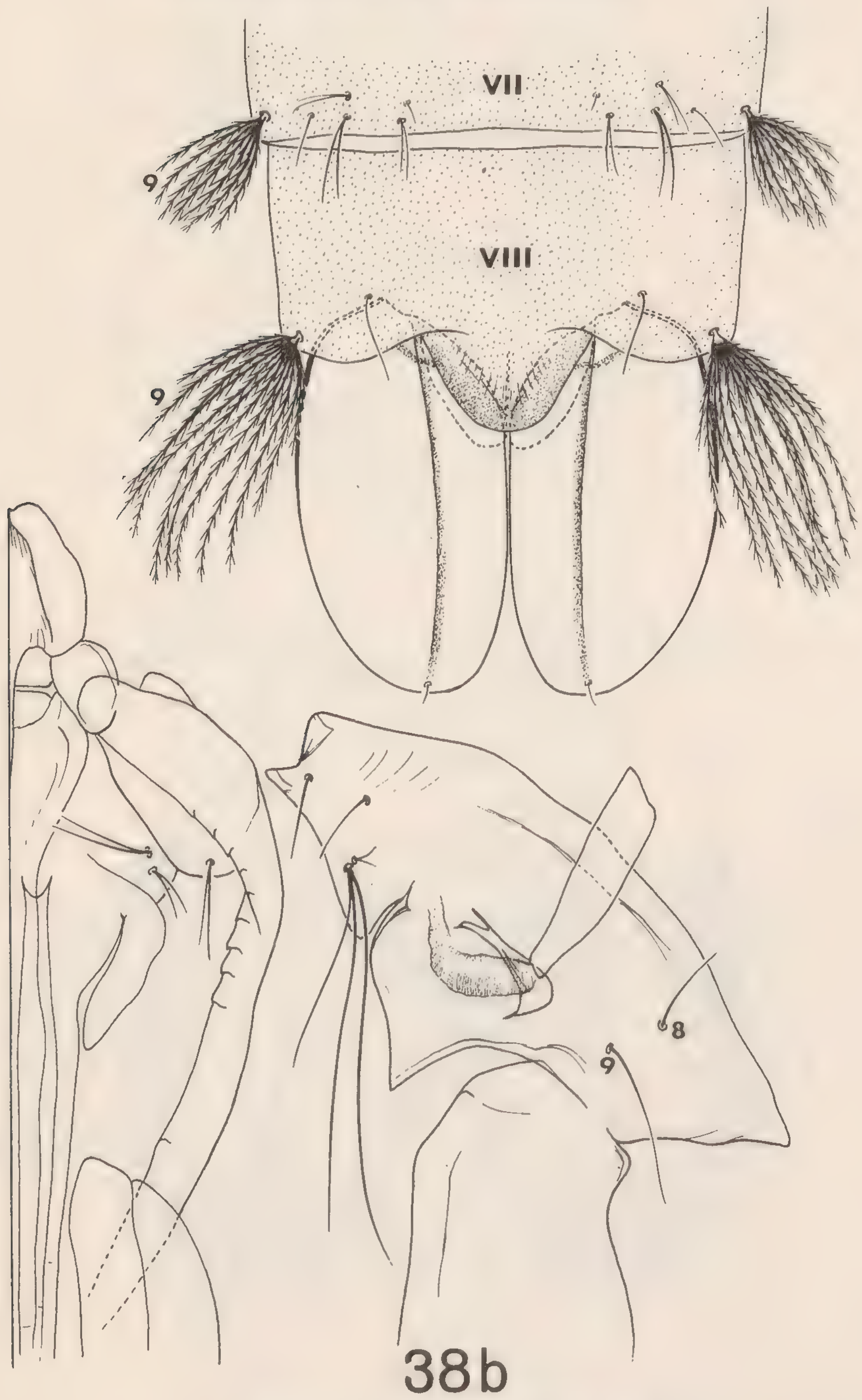
Ficalbia malfeyti

Pl. 16



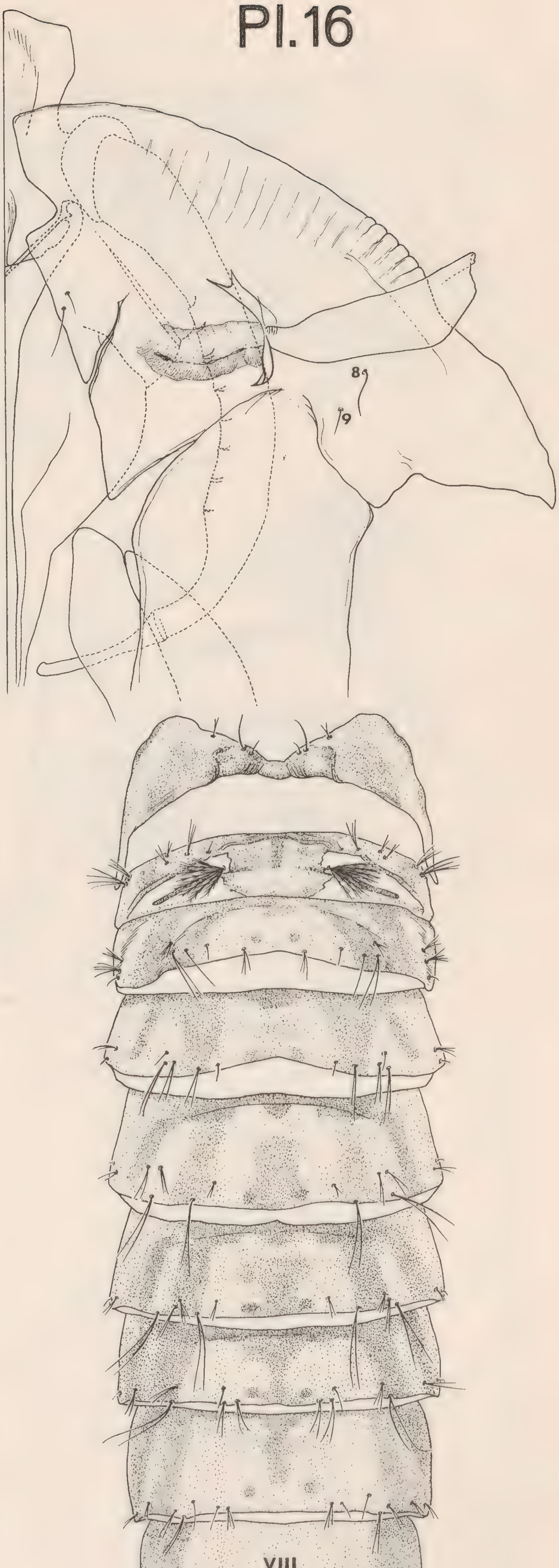
38a

Orthopodomyia flavicosta



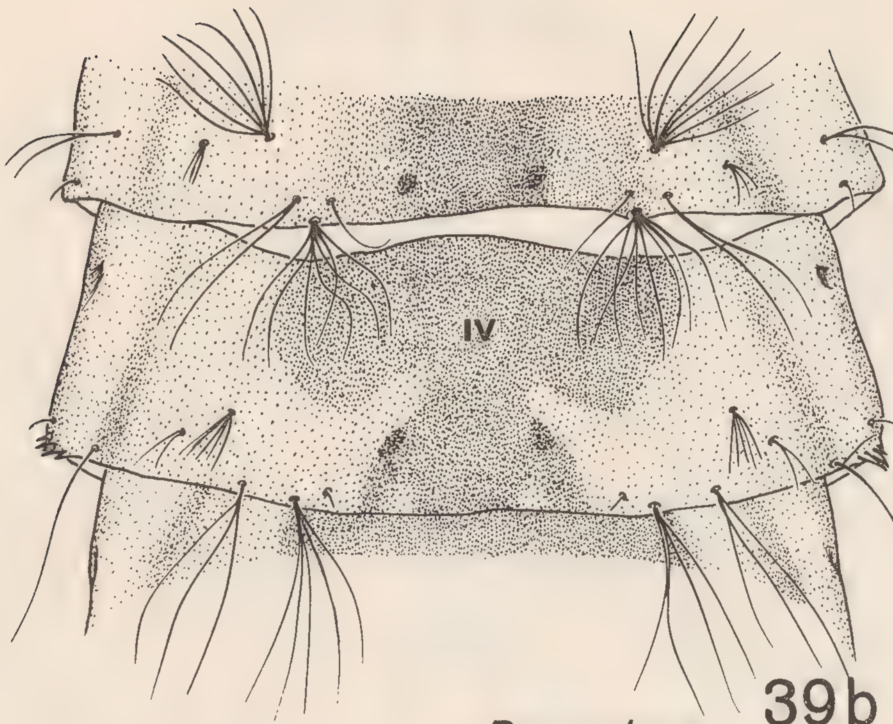
38b

Orthopodomyia wilsoni



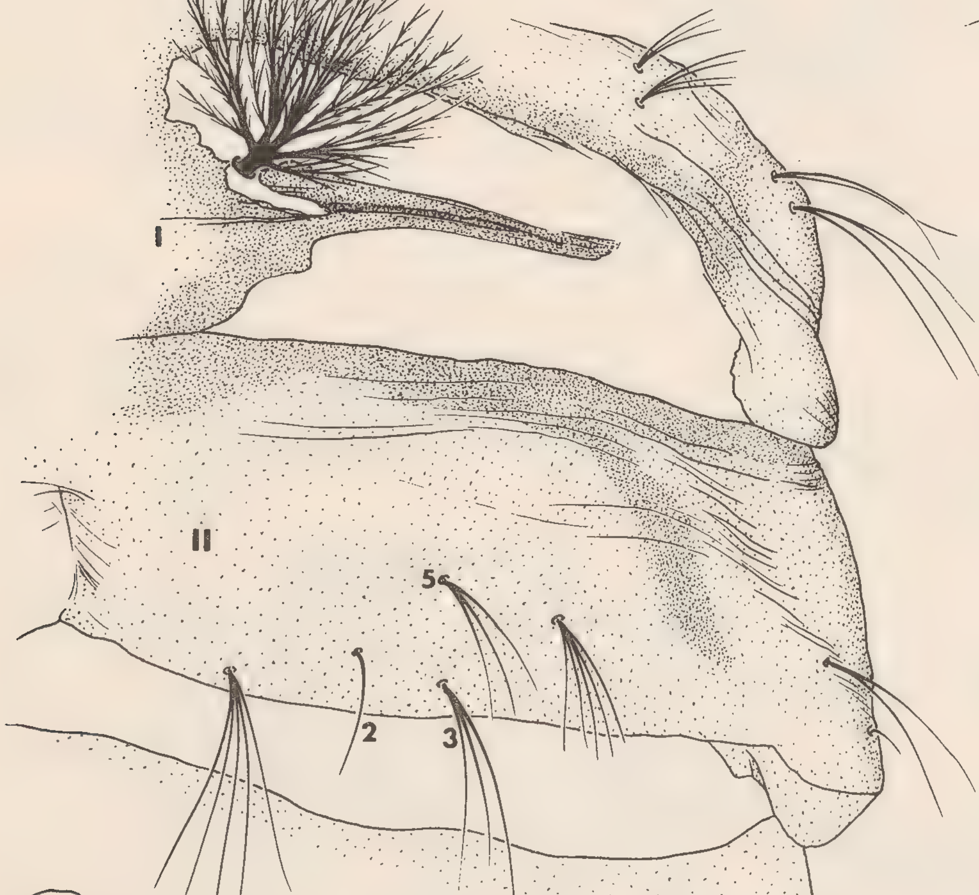
39a

Psorophora ciliata



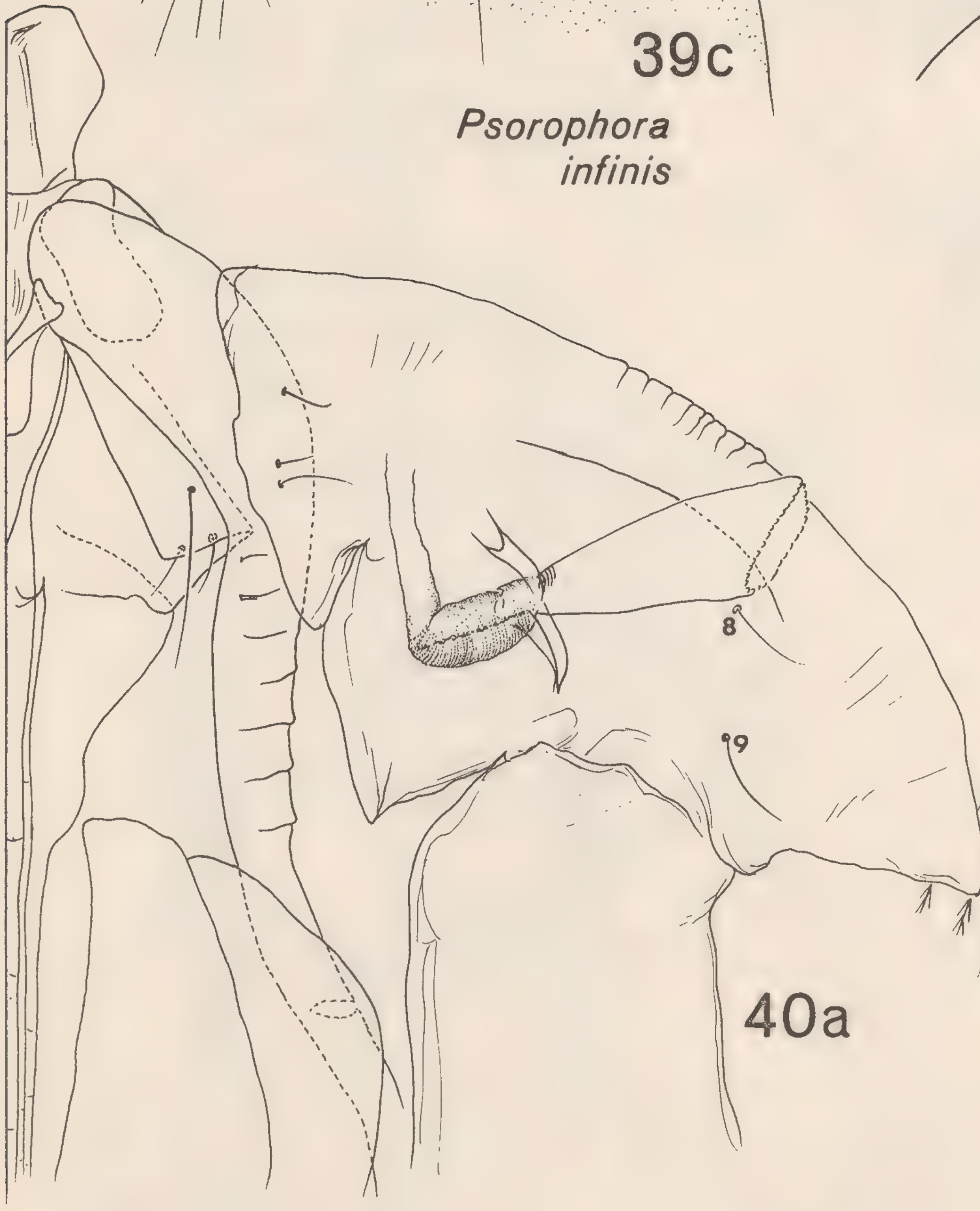
39b

Psorophora ferox

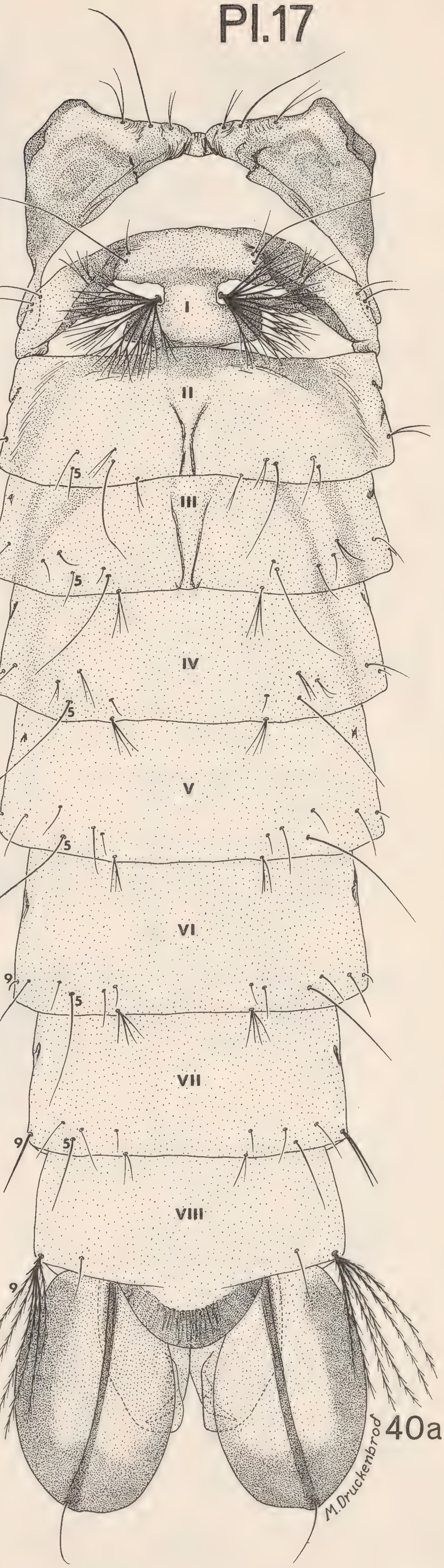


39c

Psorophora infinis



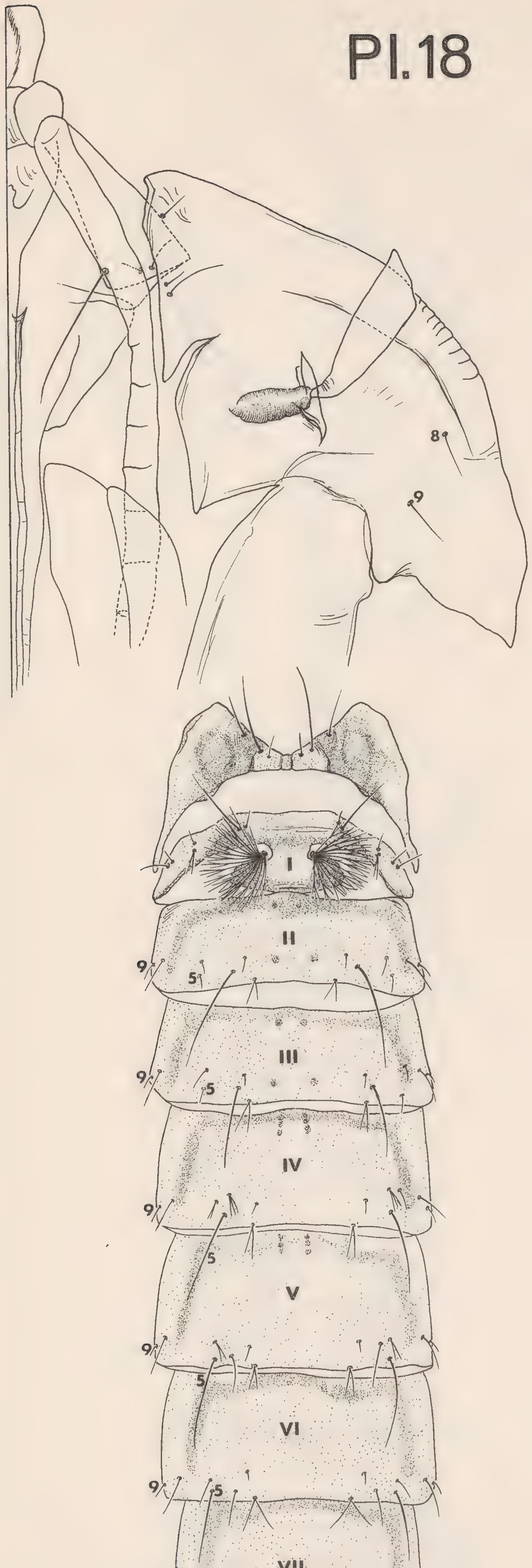
40a



40a

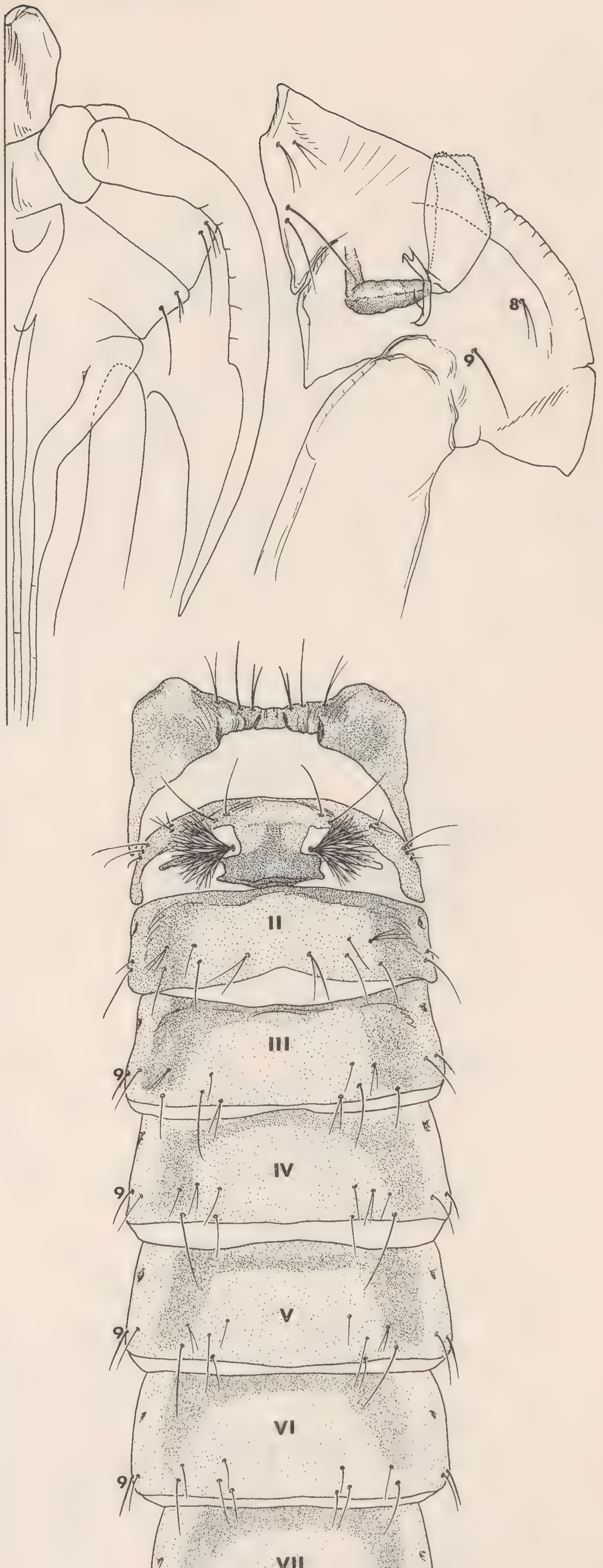
Haemagogus spegazzinii

Pl. 18



40b

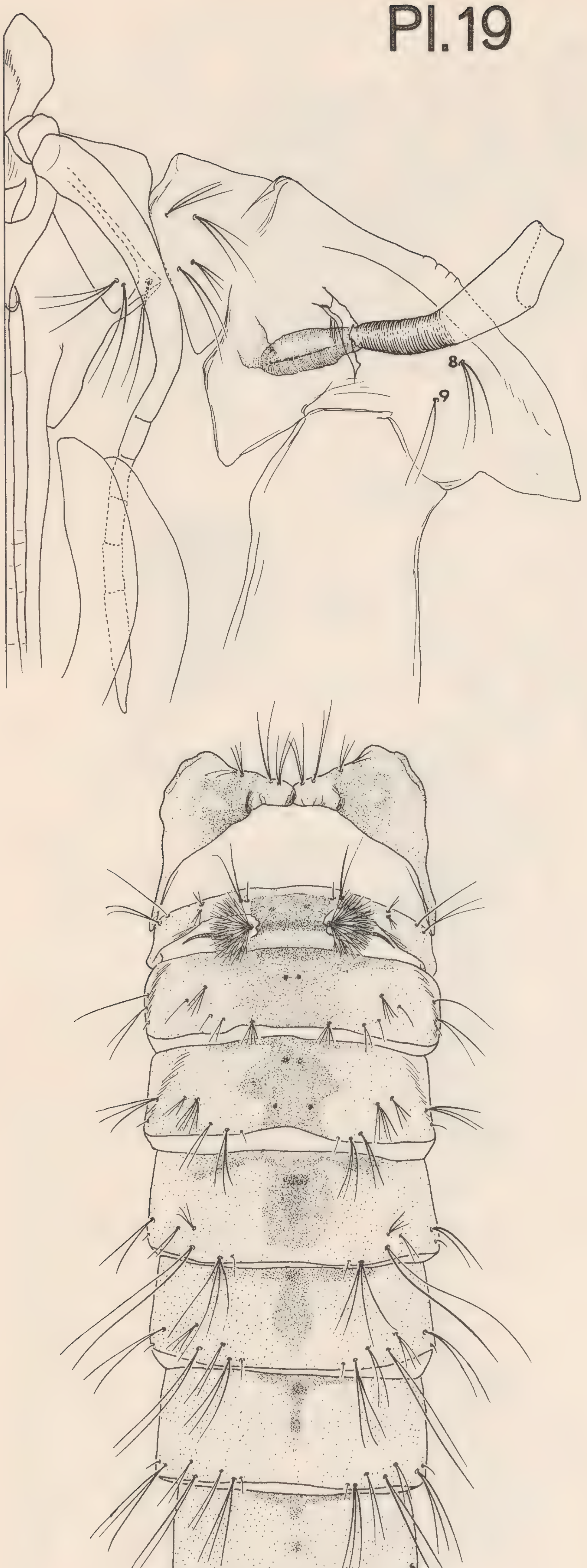
Haemagogus capricornii



40c

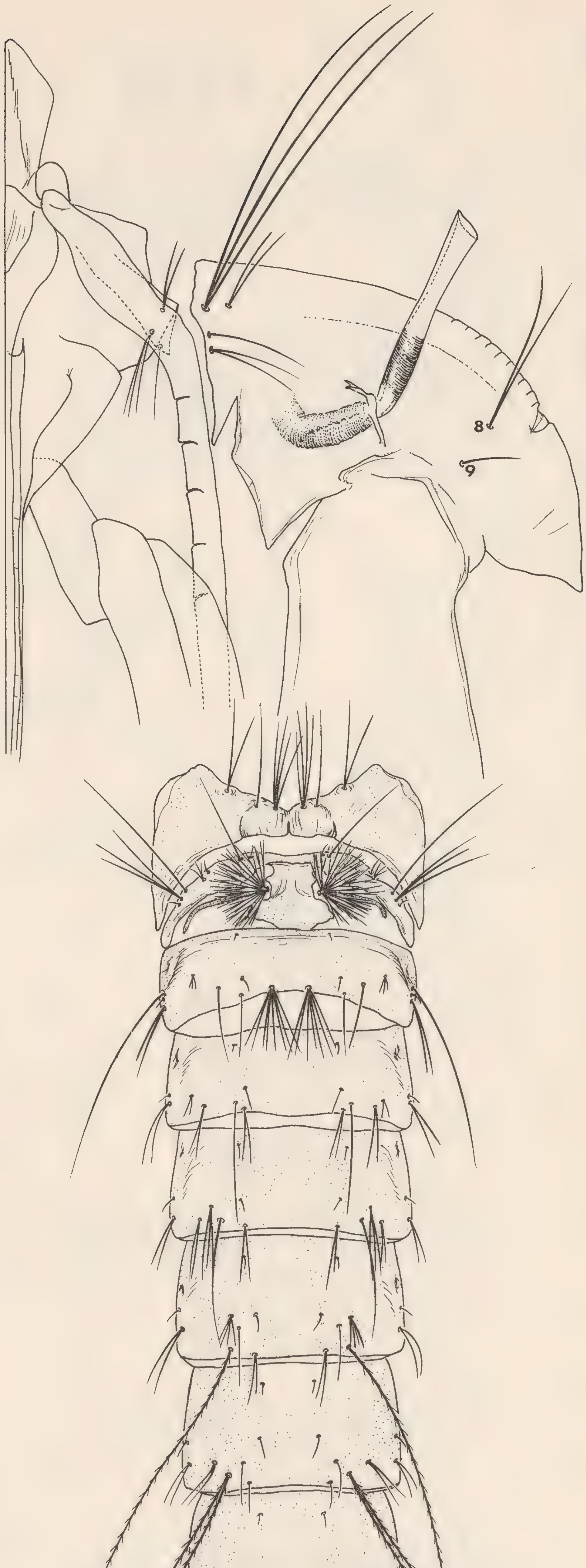
Aedes aegypti

Pl. 19



41a

Culex pipiens

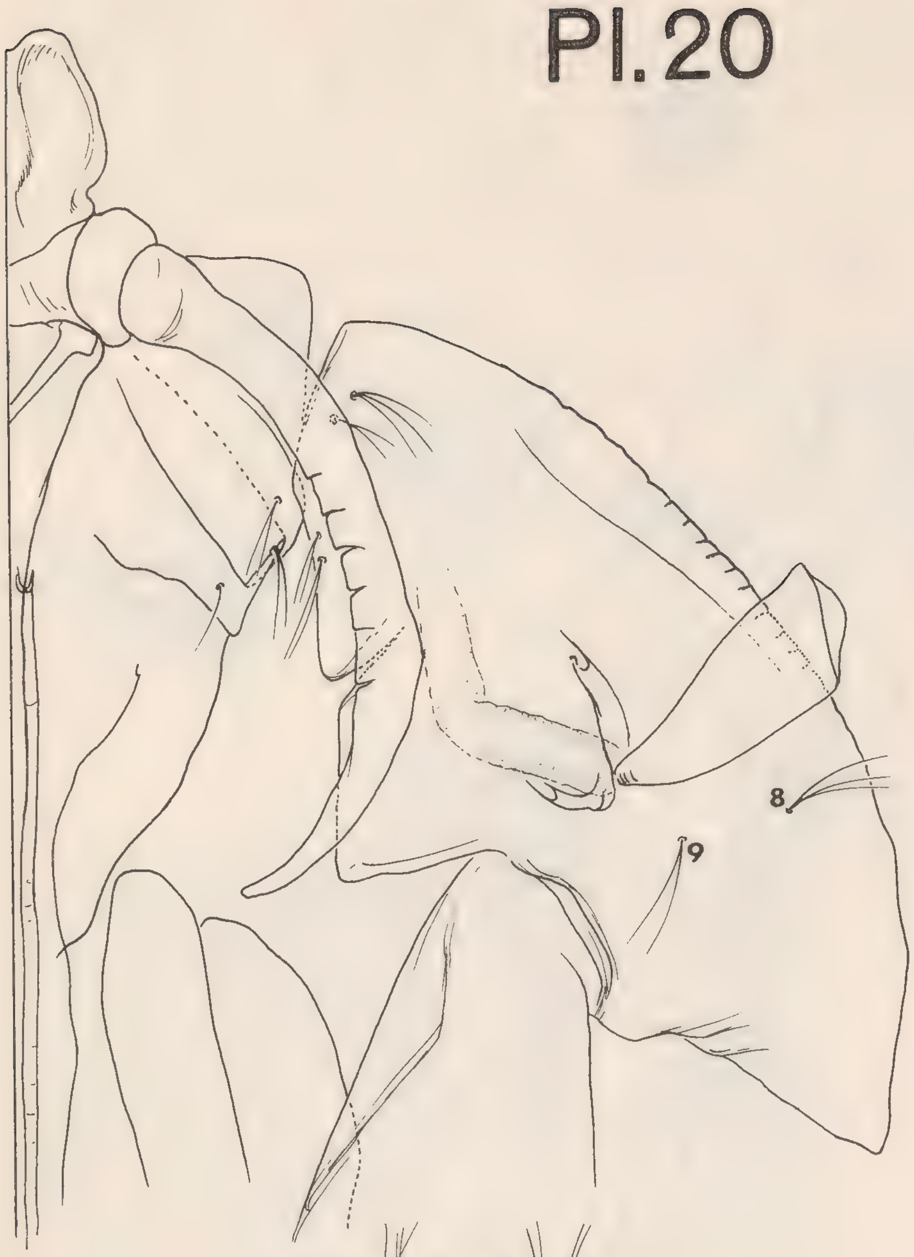


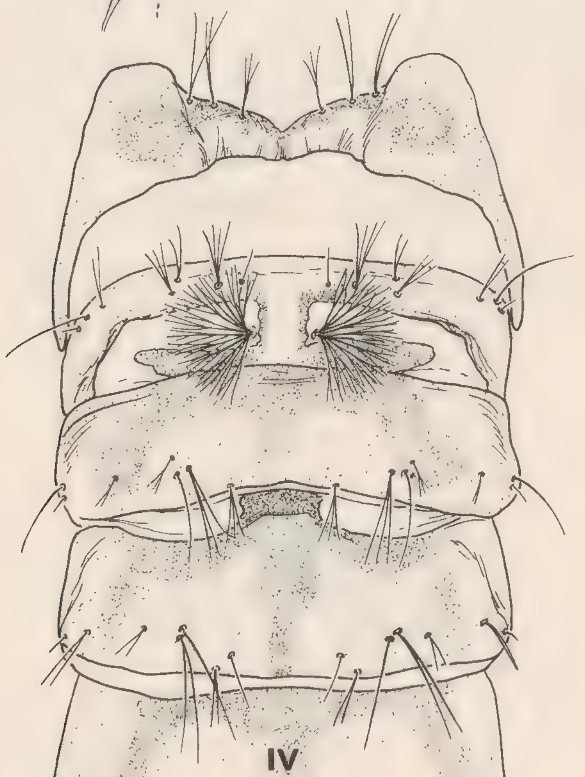
M.Druckenbrod

41b

Culex antillummagnorum

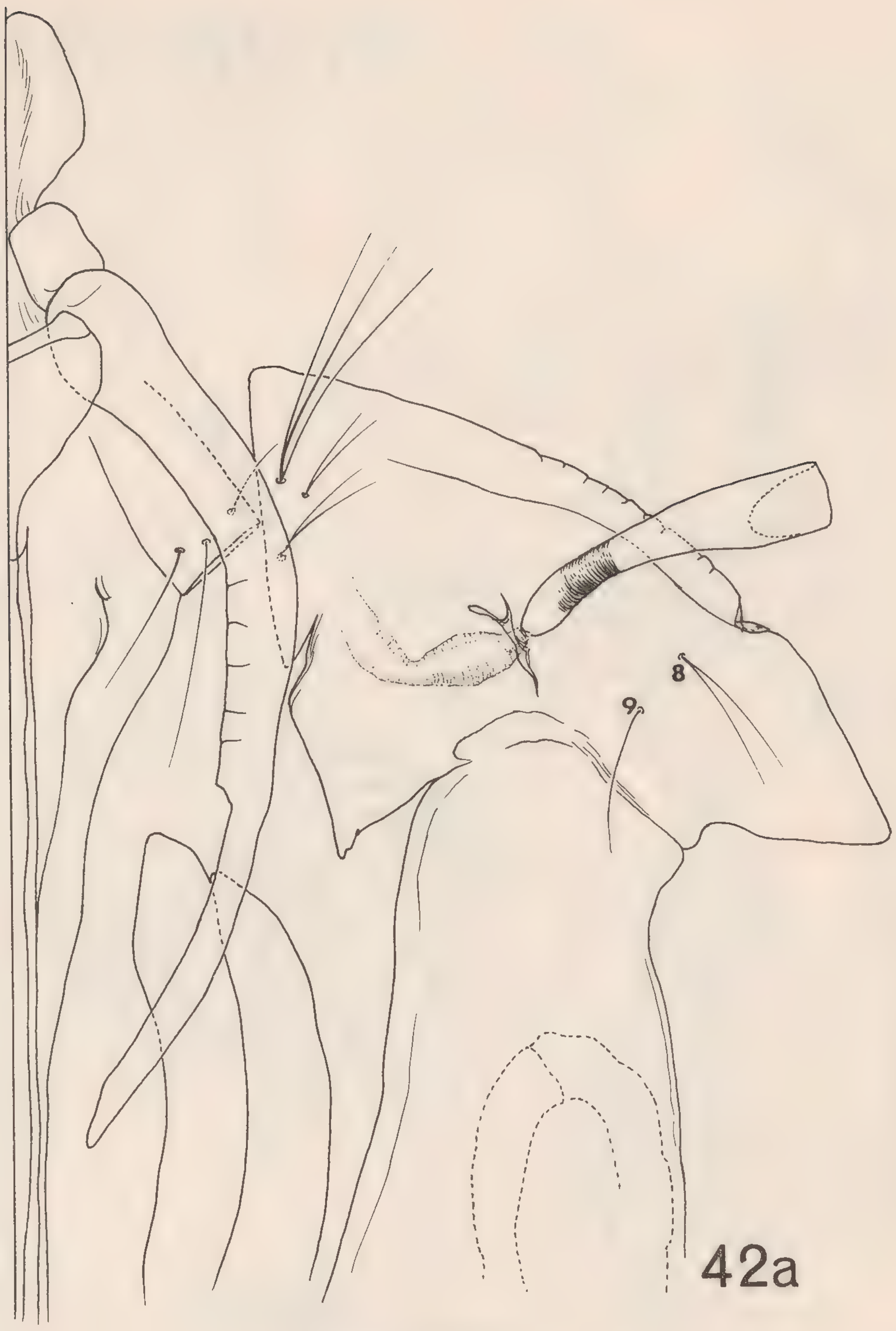
Pl. 20





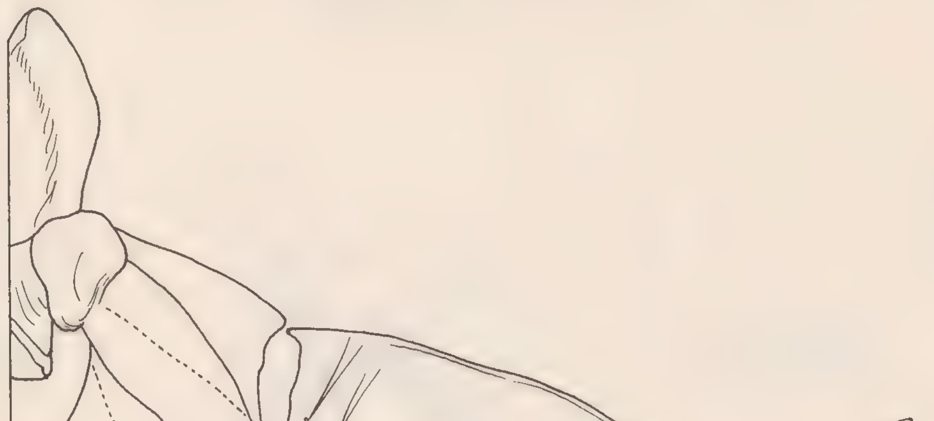
41c

Culiseta longiareolata



42a

Culex davisi

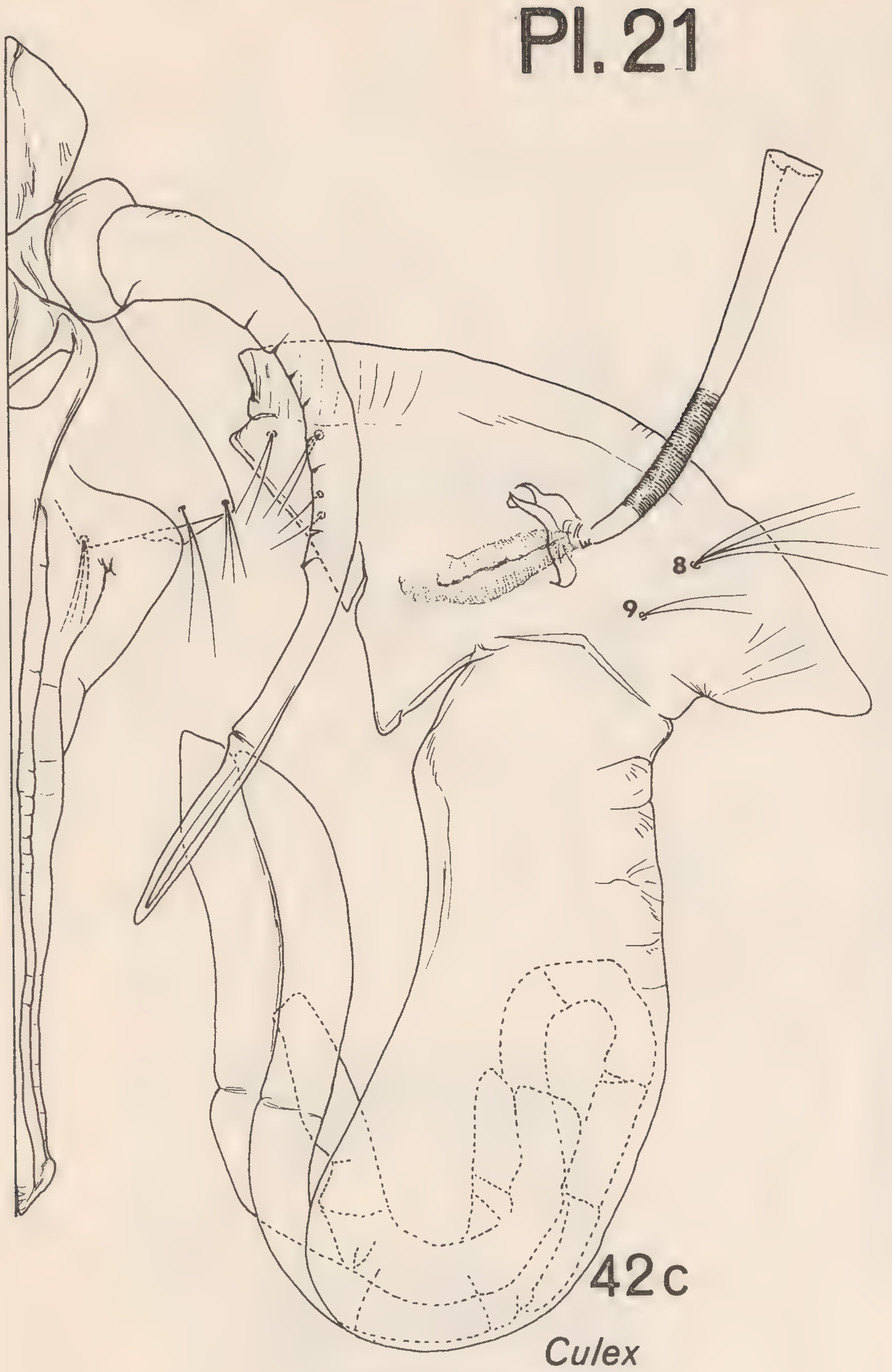


M. Druckenbrod

42b

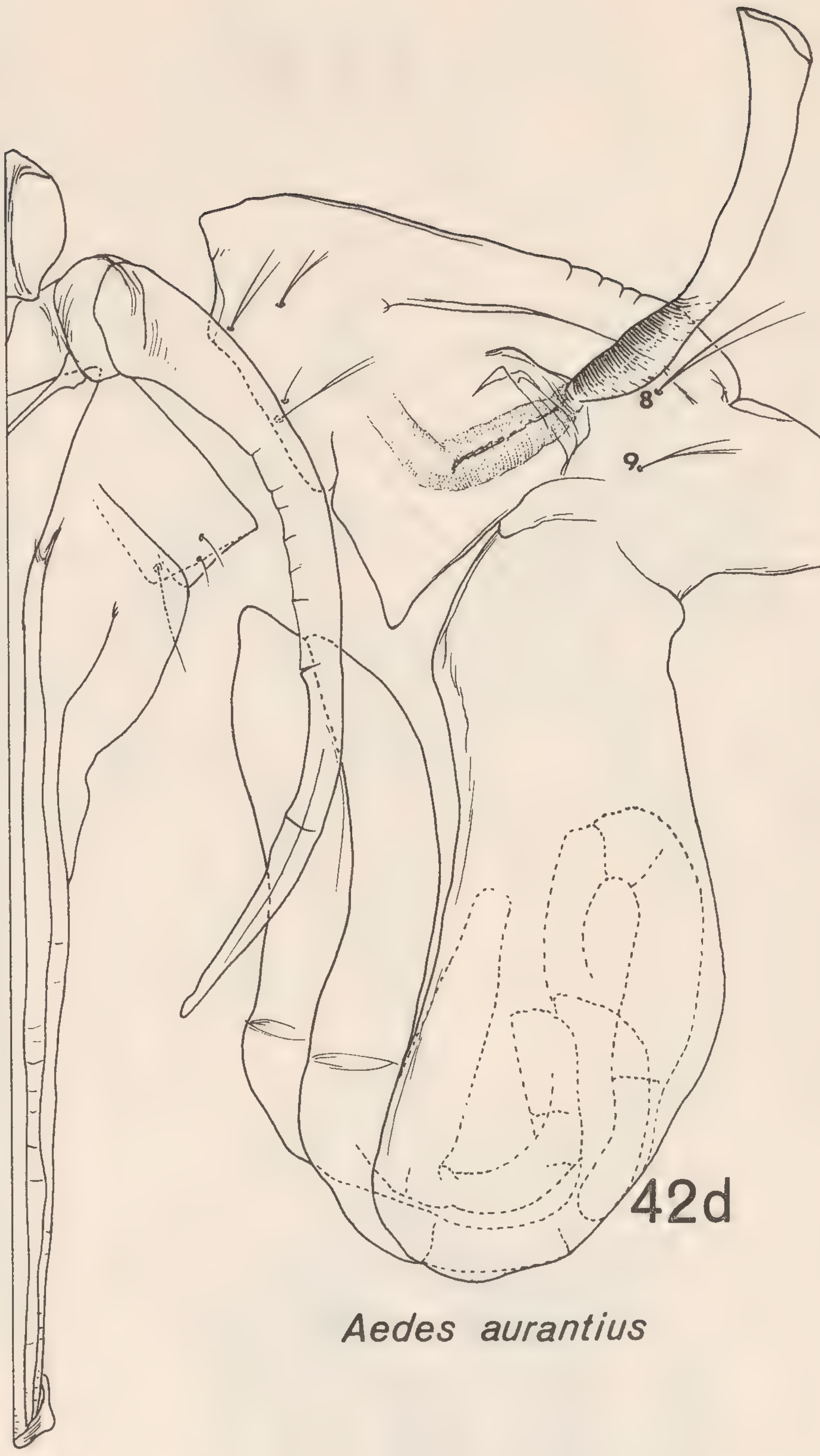
Culex bamborum

Pl. 21



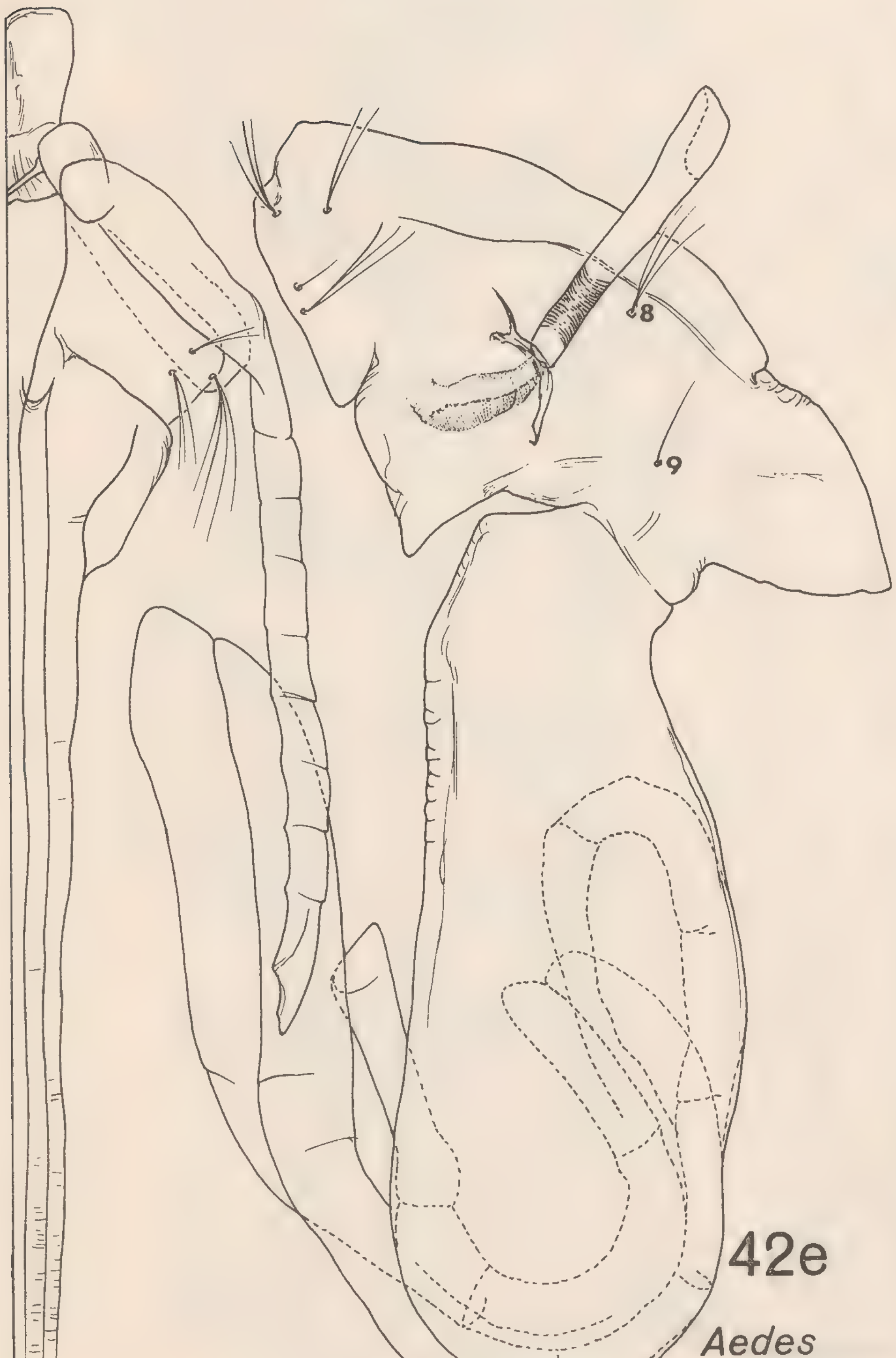
42c

Culex pseudomelanoconia



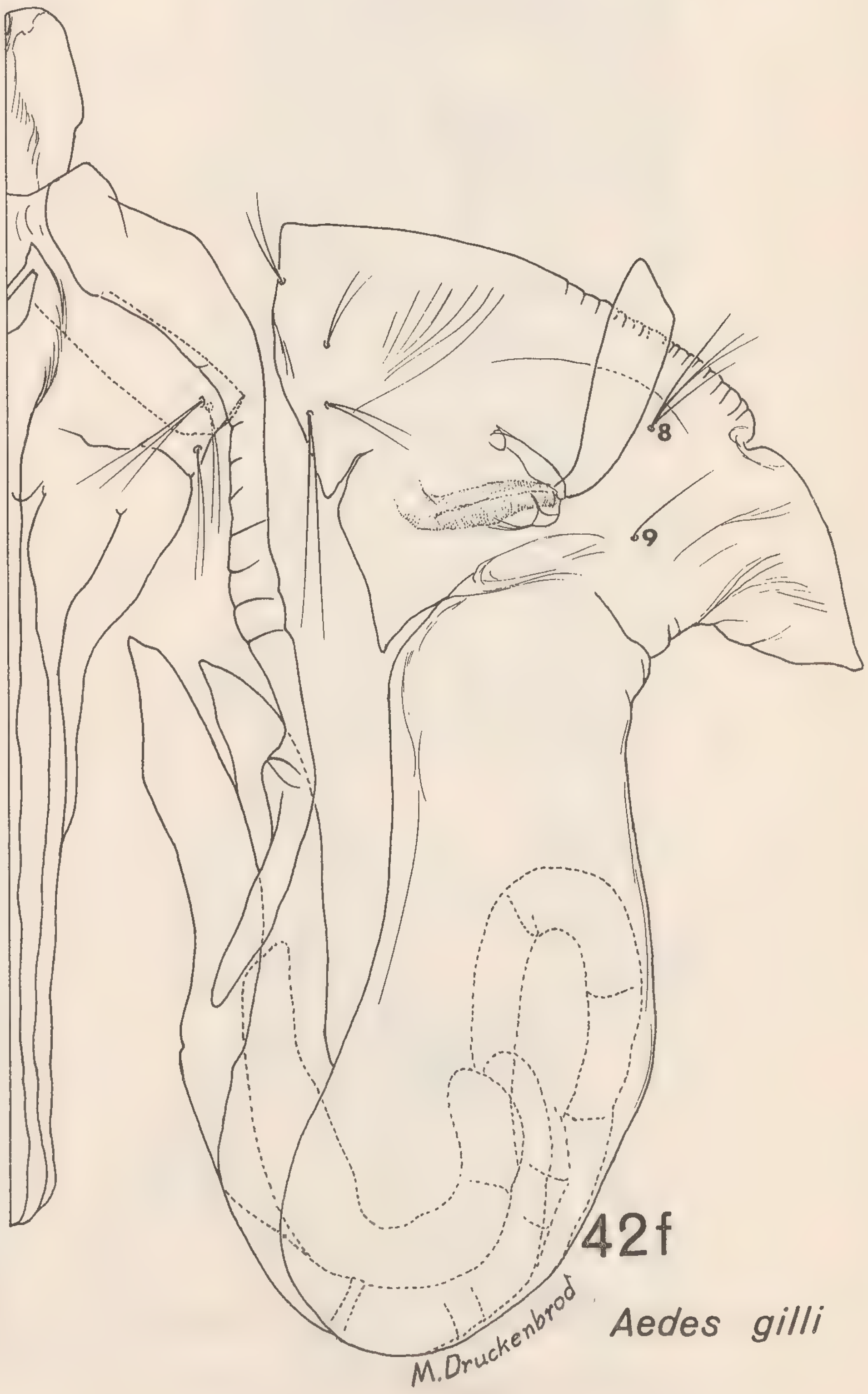
42d

Aedes aurantius



42e

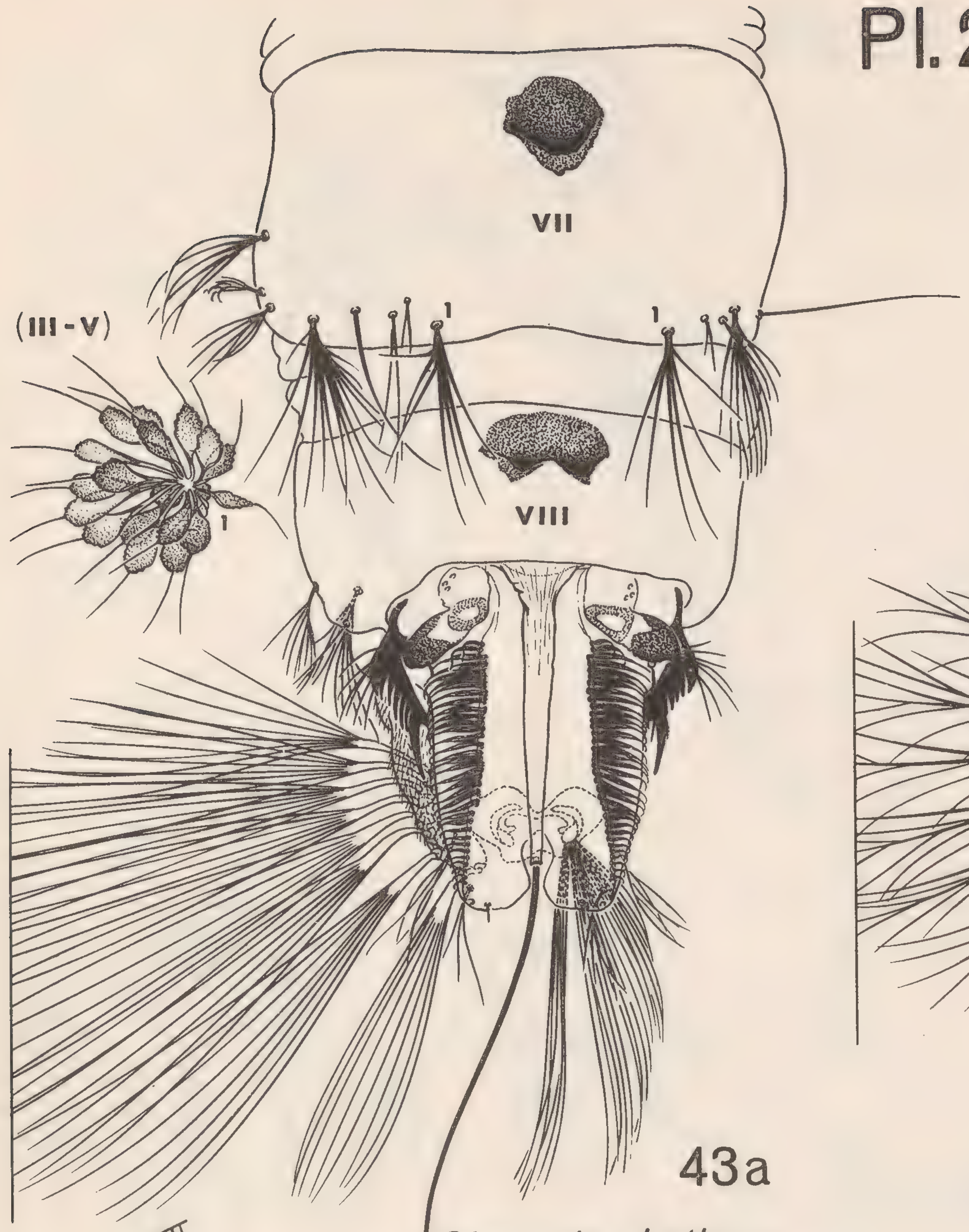
Aedes longirostris



42f

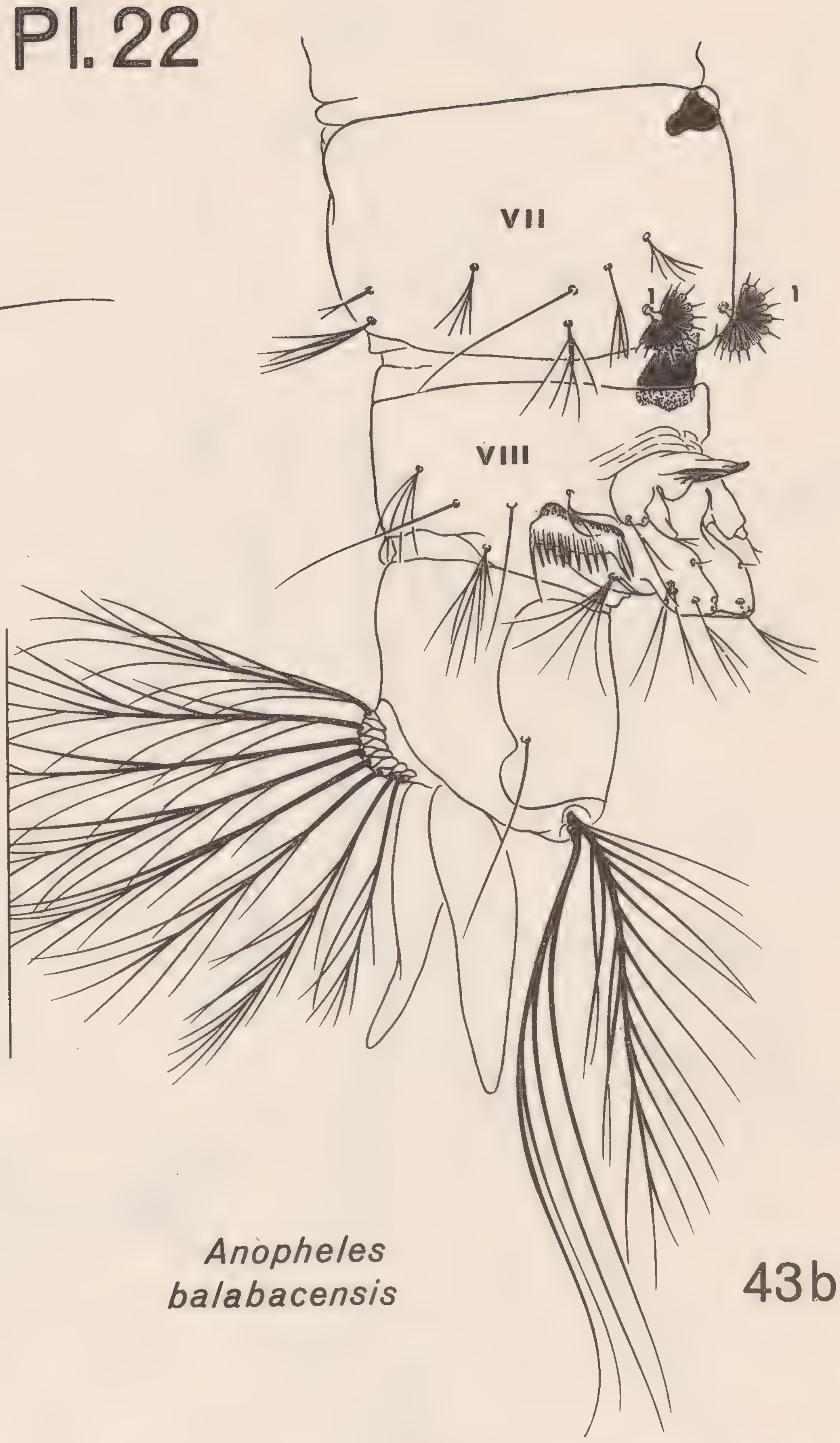
Aedes gilli

Pl. 22



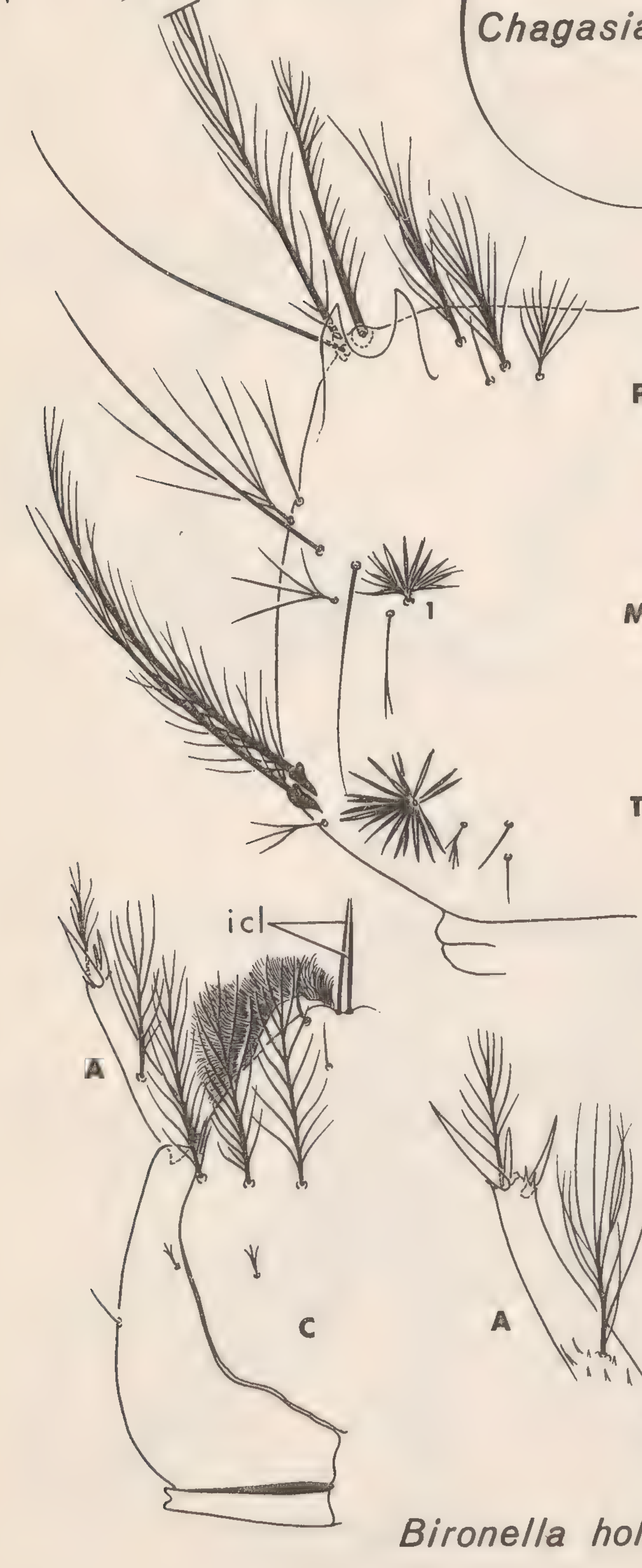
43a

Chagasia bathana



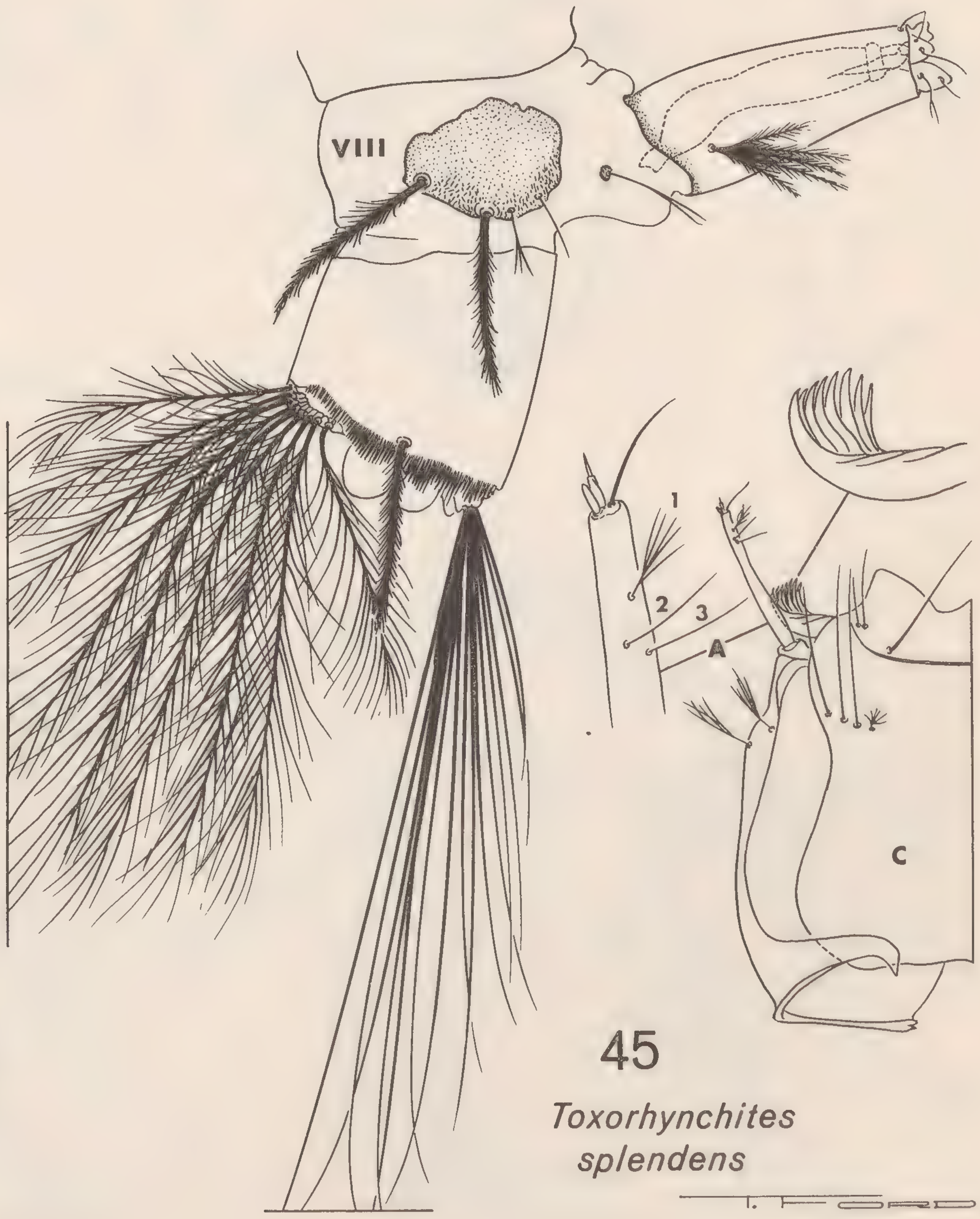
Anopheles balabacensis

43b



44

Bironella hollandi

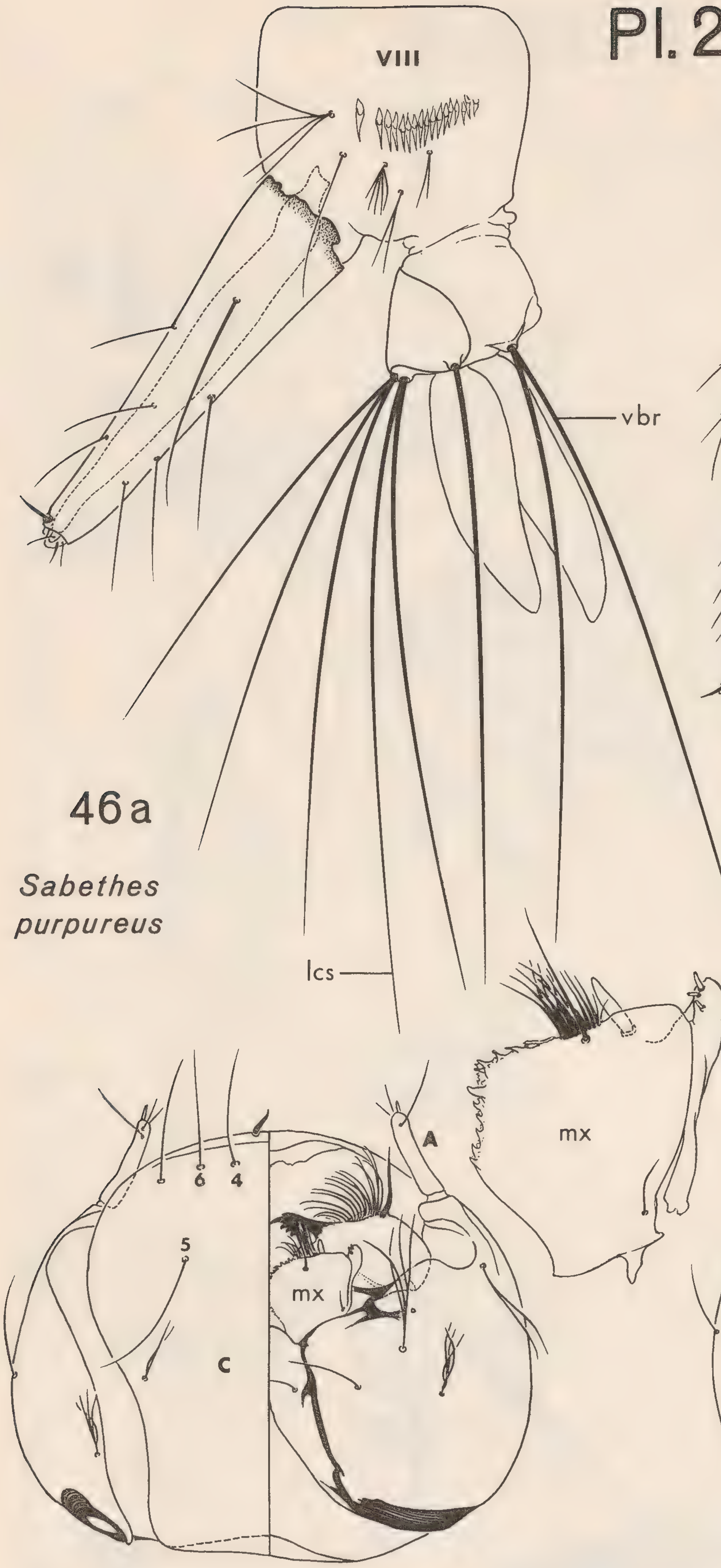


45

Toxorhynchites splendens

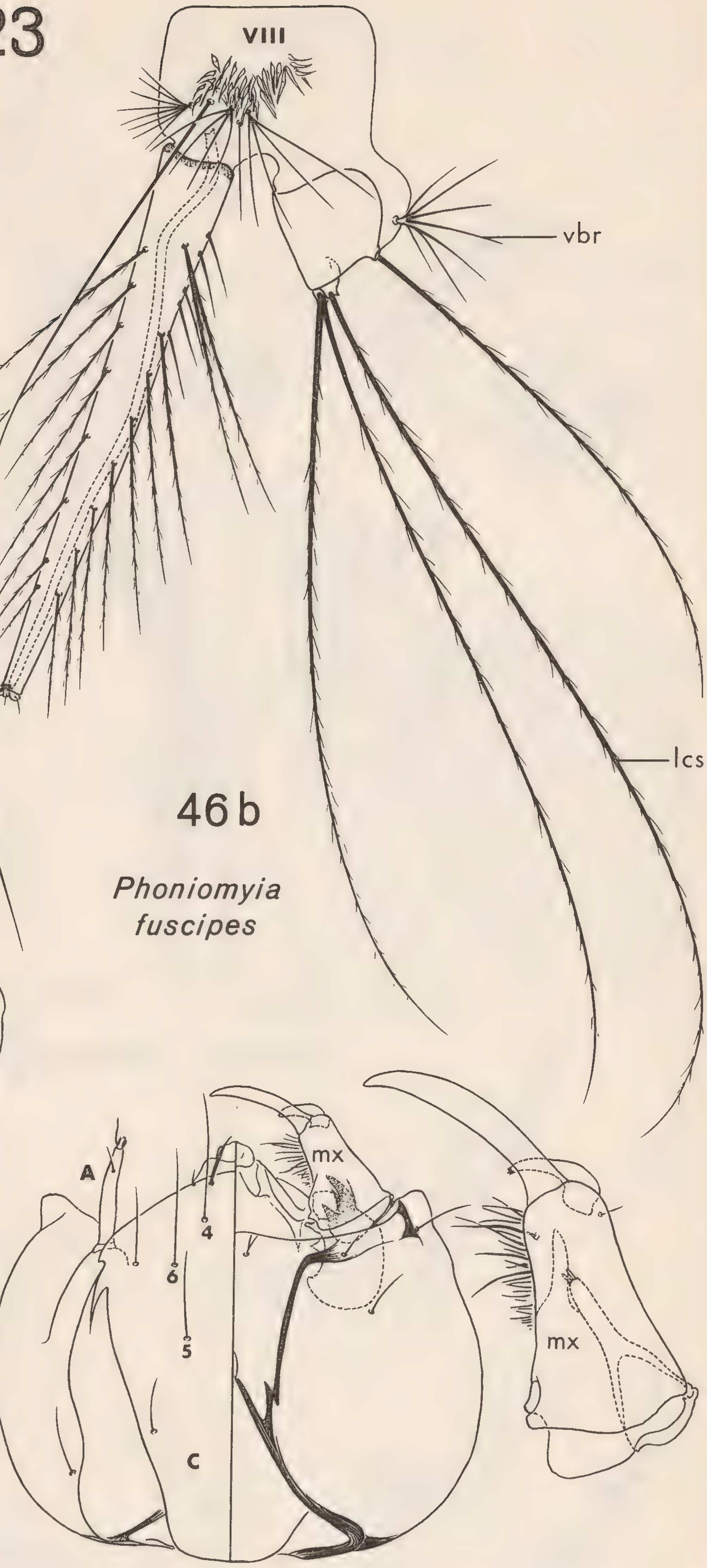
T. FORD

Pl. 23



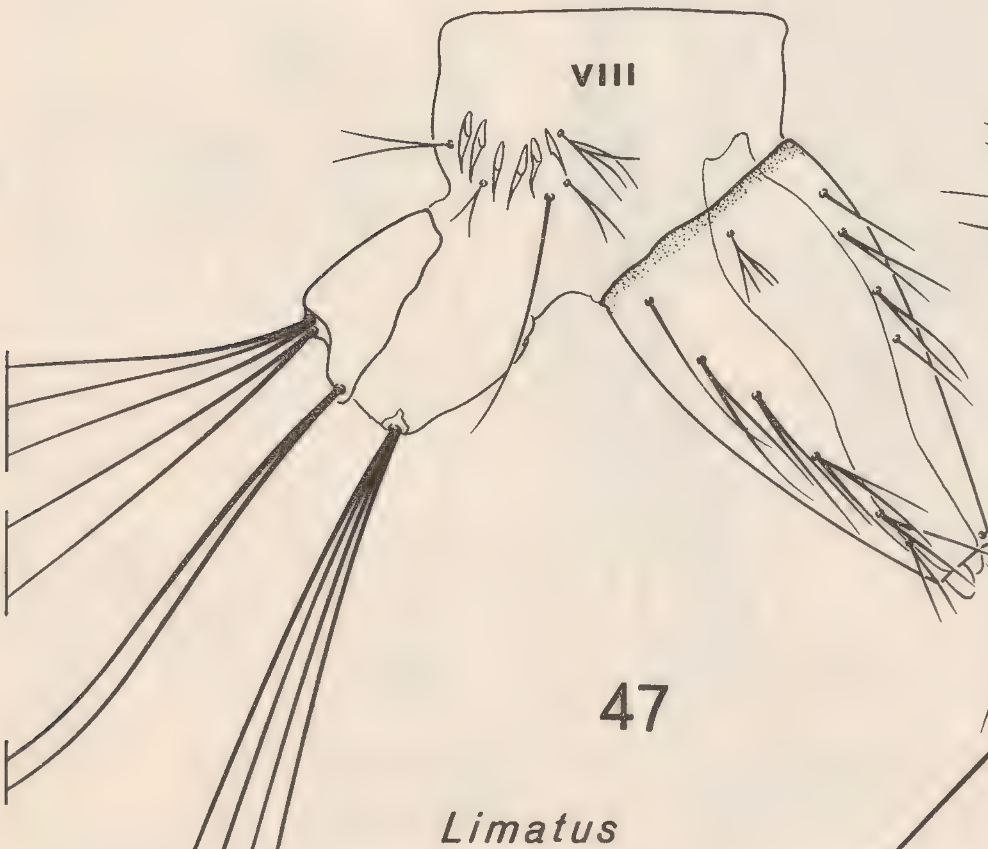
46a

Sabethes purpureus



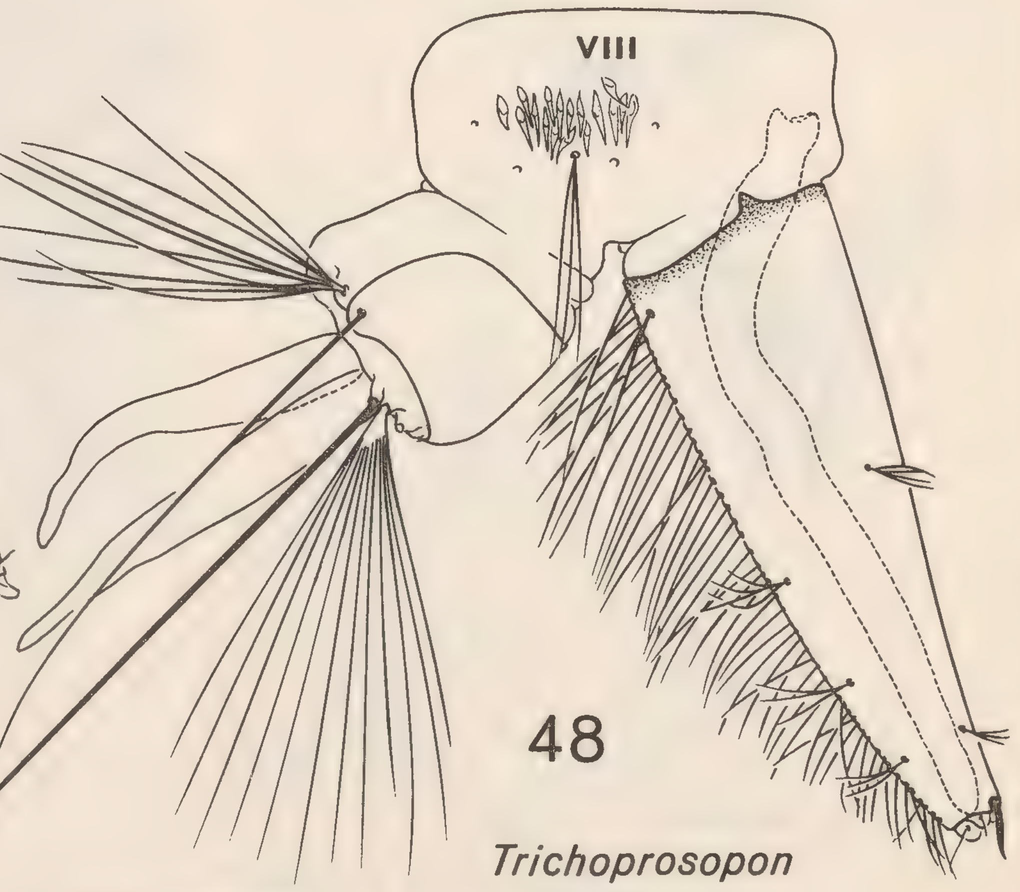
46b

Phoniomyia fuscipes



47

Limatus durhamii

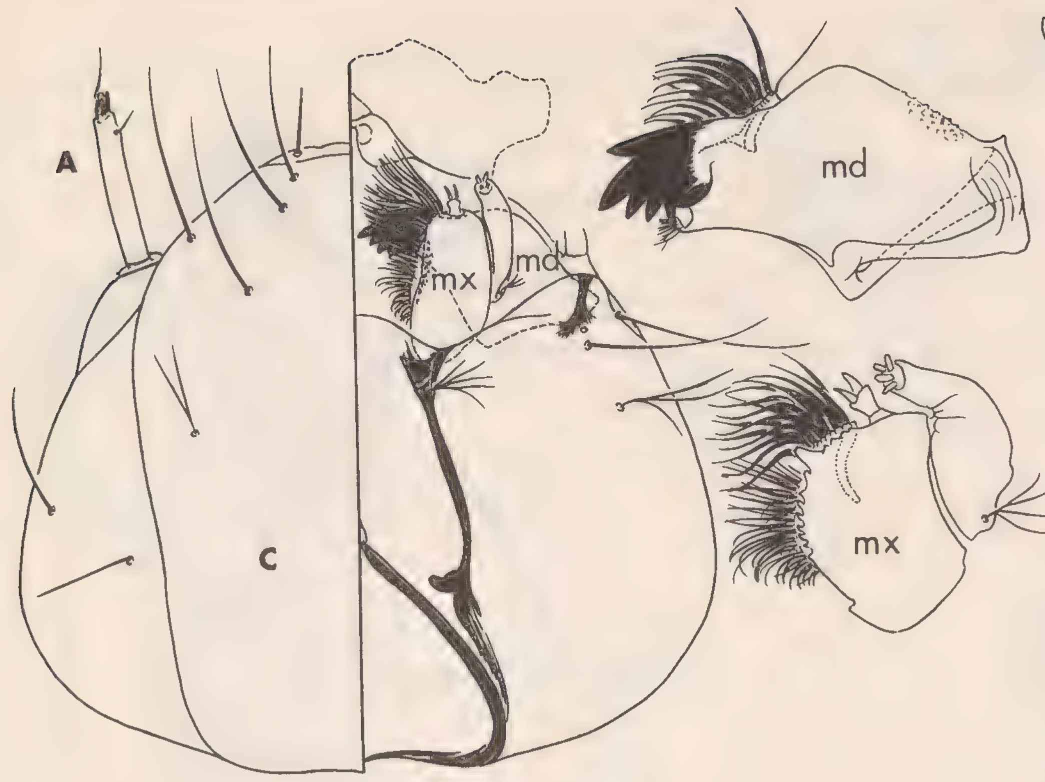


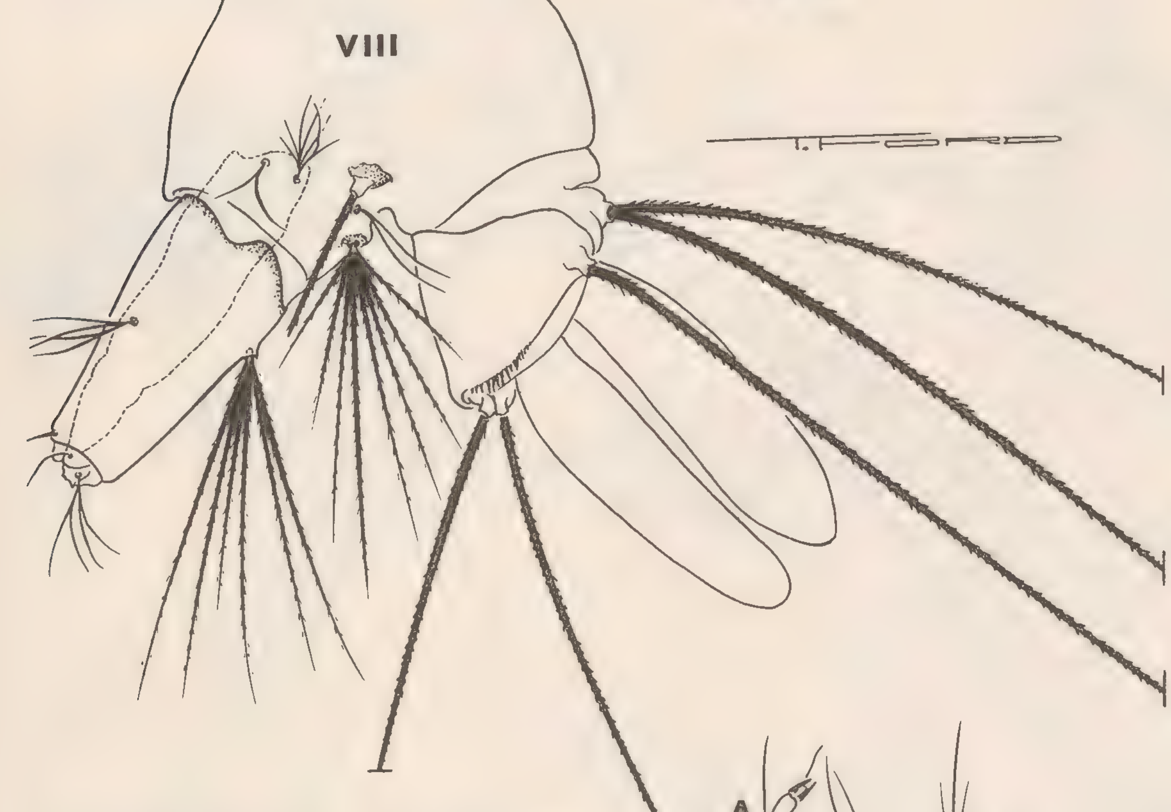
48

Trichoprosopon frontosum

T. FORD

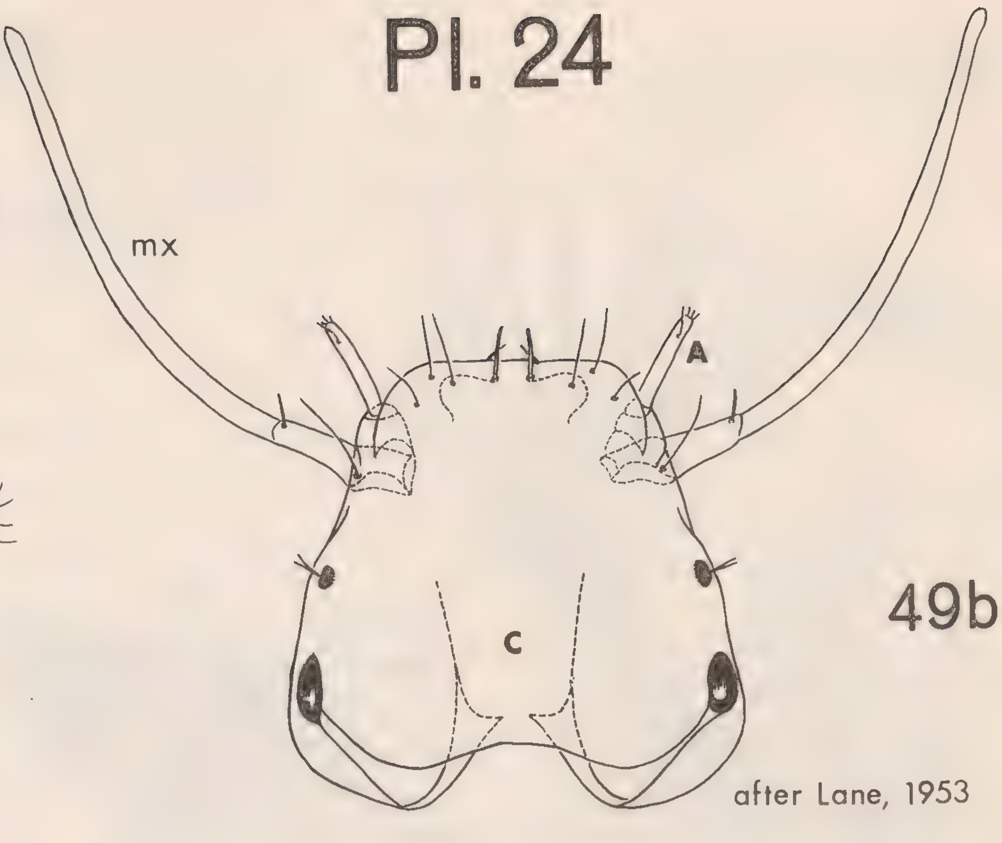
Pl. 24



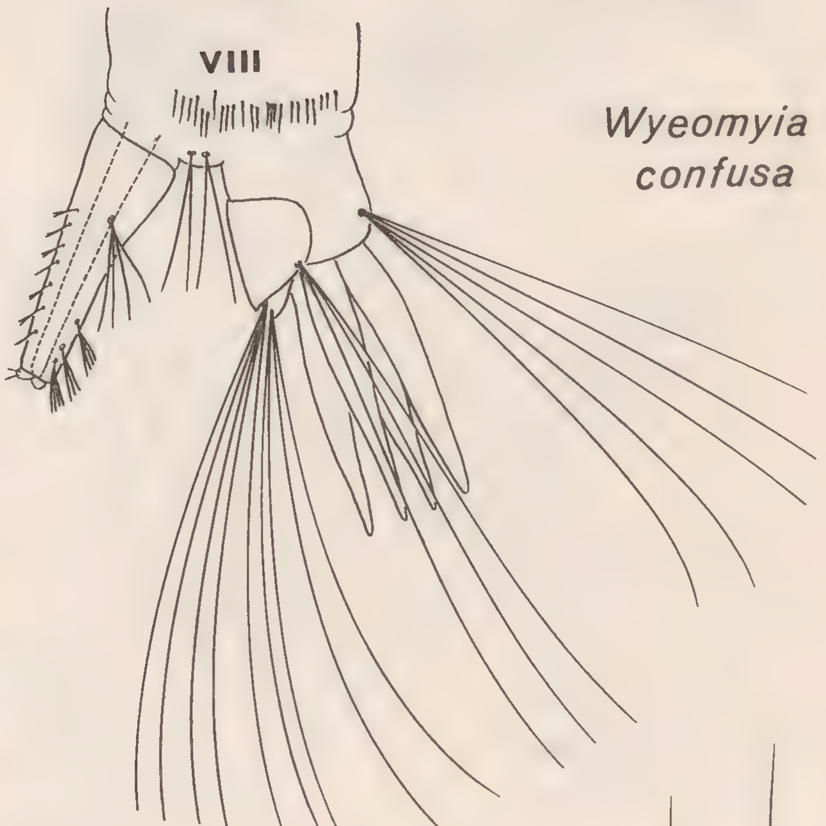


49a

Trichoprosopon digitatum

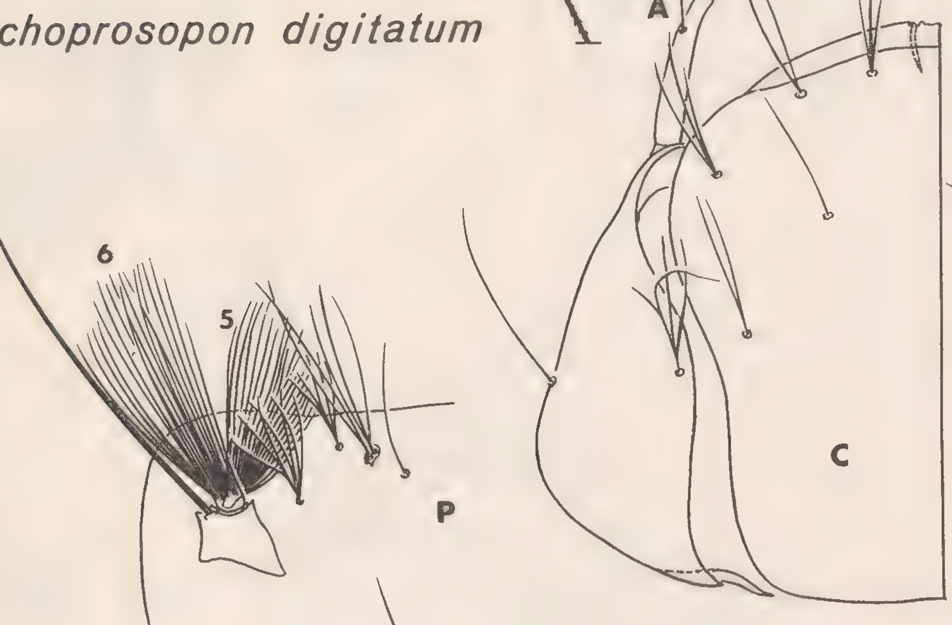


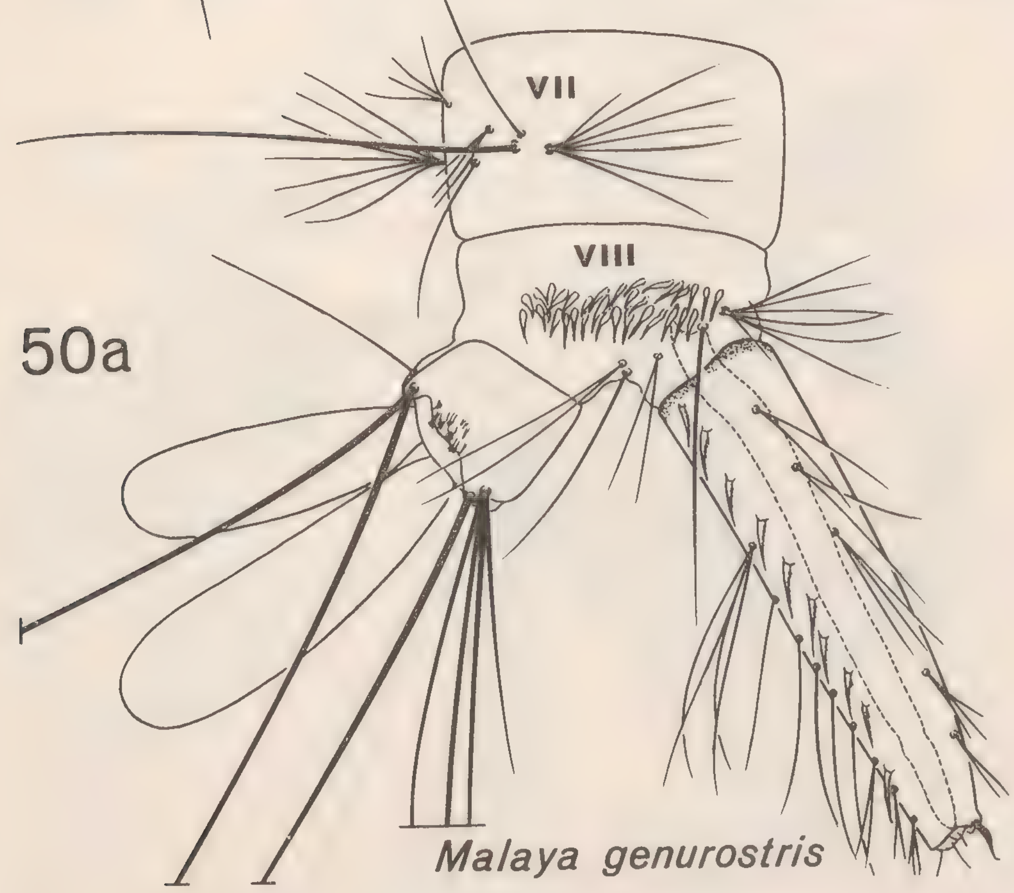
after Lane, 1953



49b

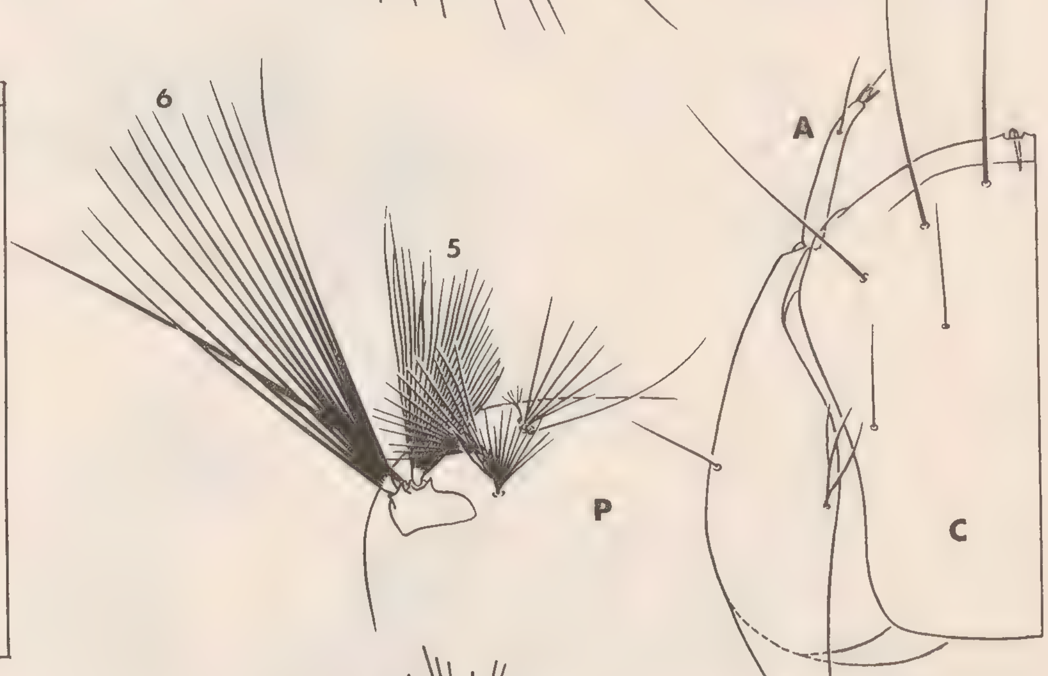
Wyeomyia confusa

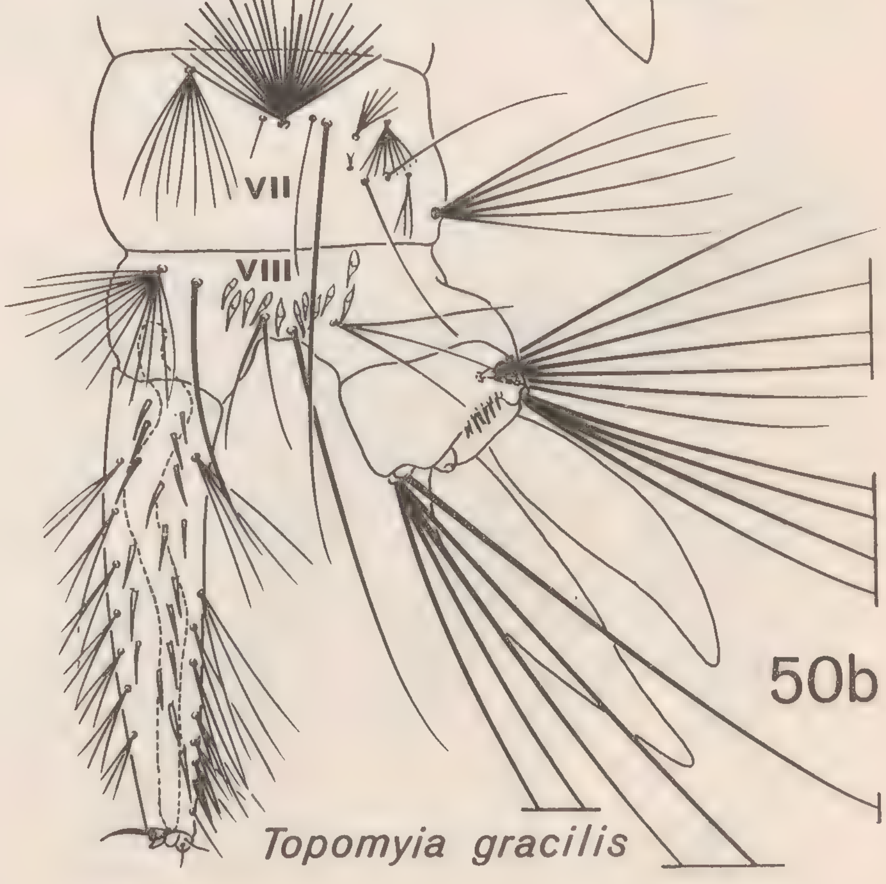




50a

Malaya genurostris

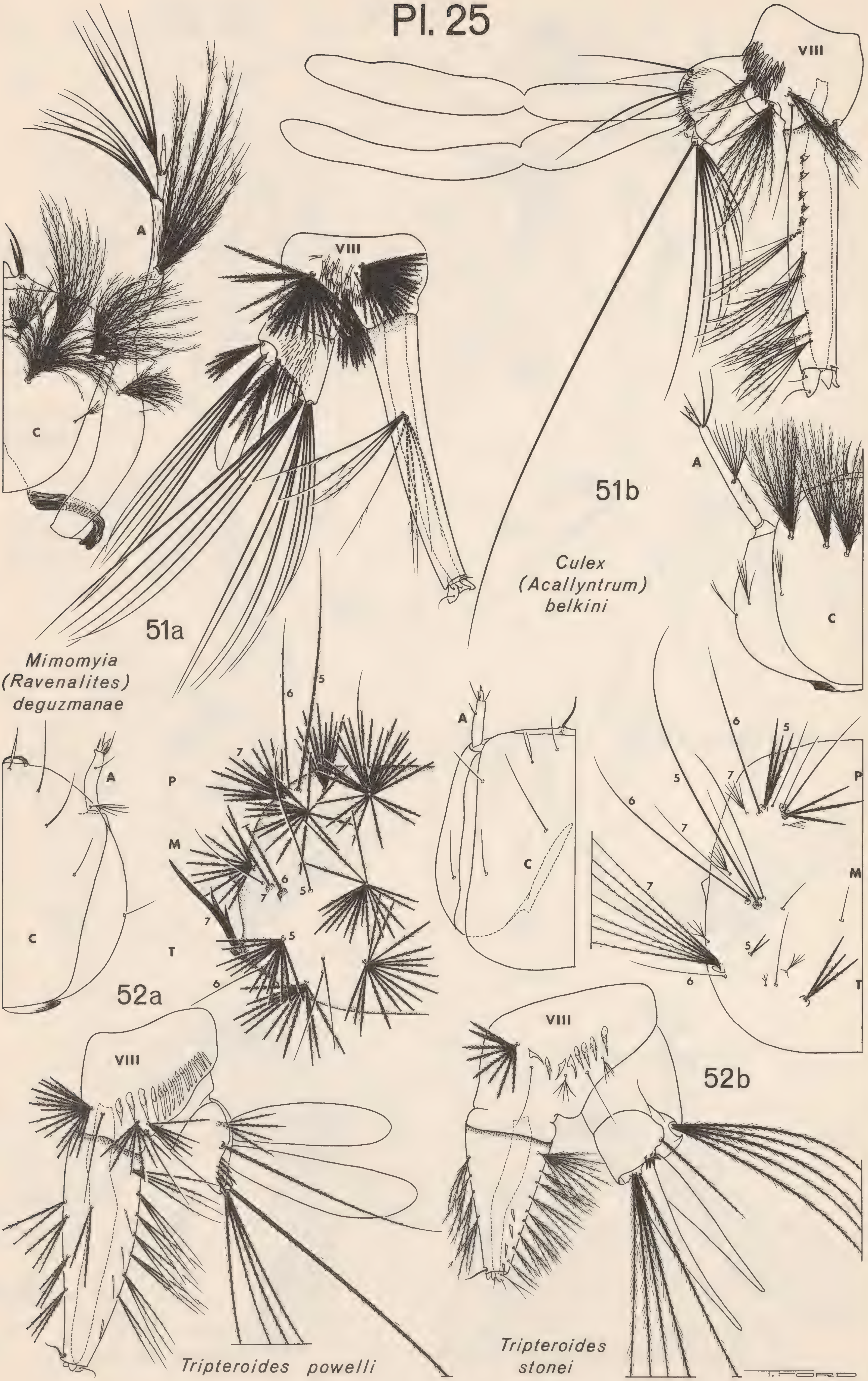




50b

Topomyia gracilis

Pl. 25



51a

Mimomyia (Ravenalites) deguzmanae

51b

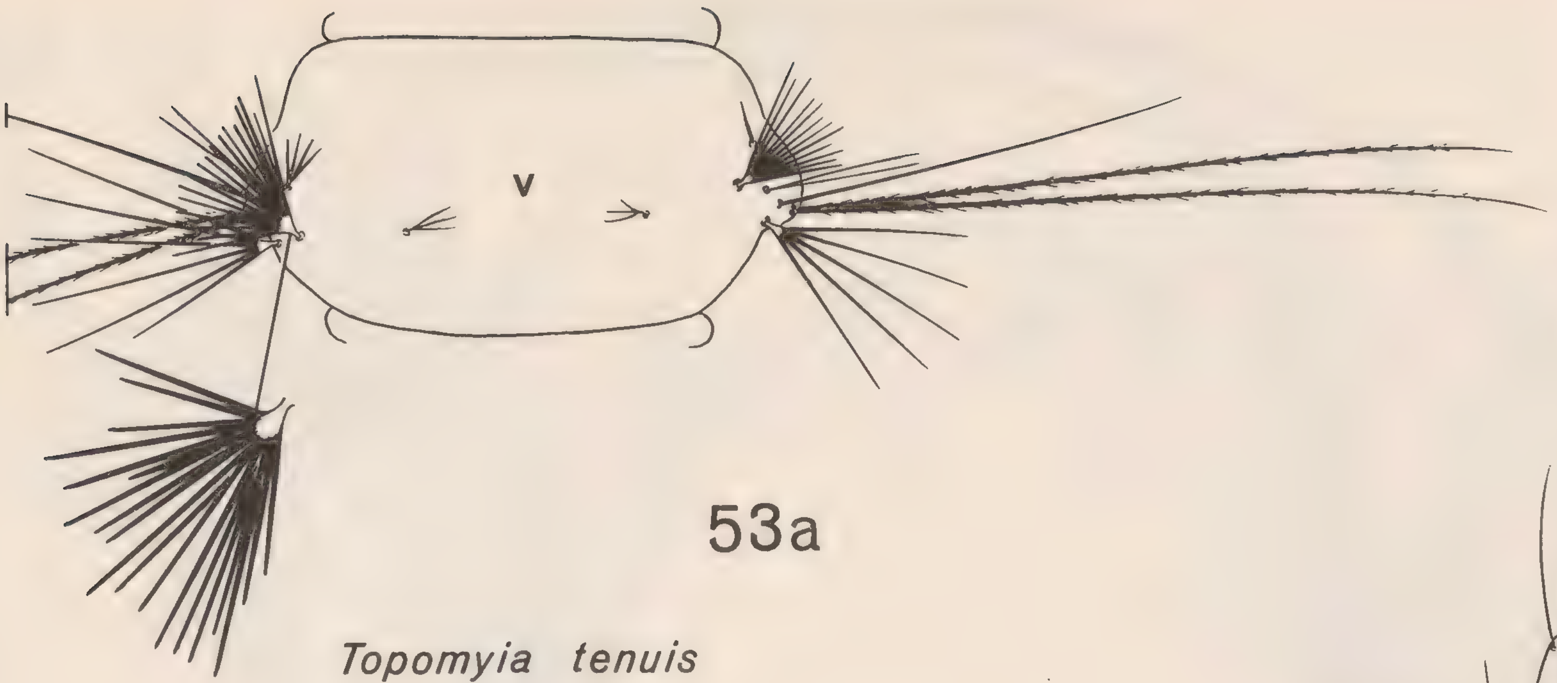
Culex (Acallyntrum) belkini

52a

Tripteroides powelli

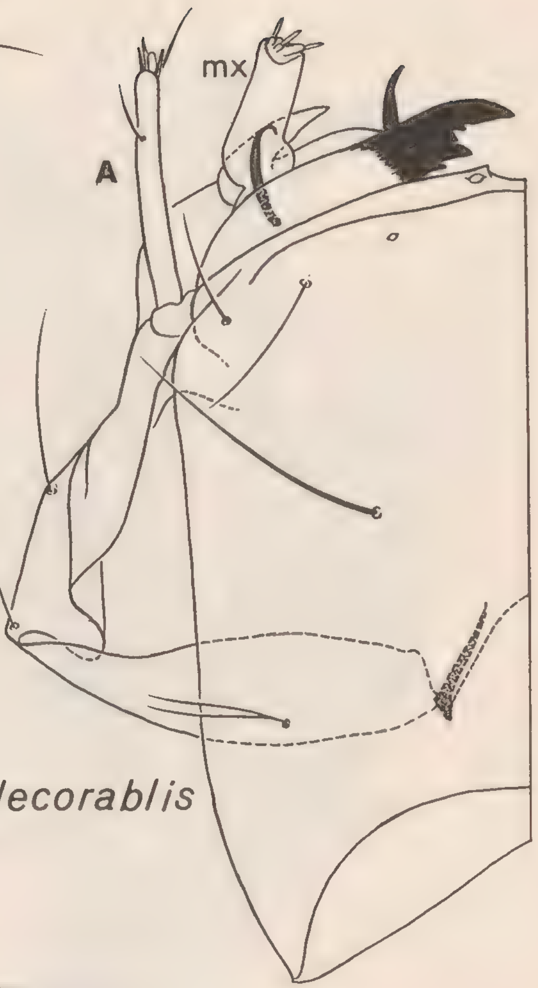
52b

Tripteroides stonei



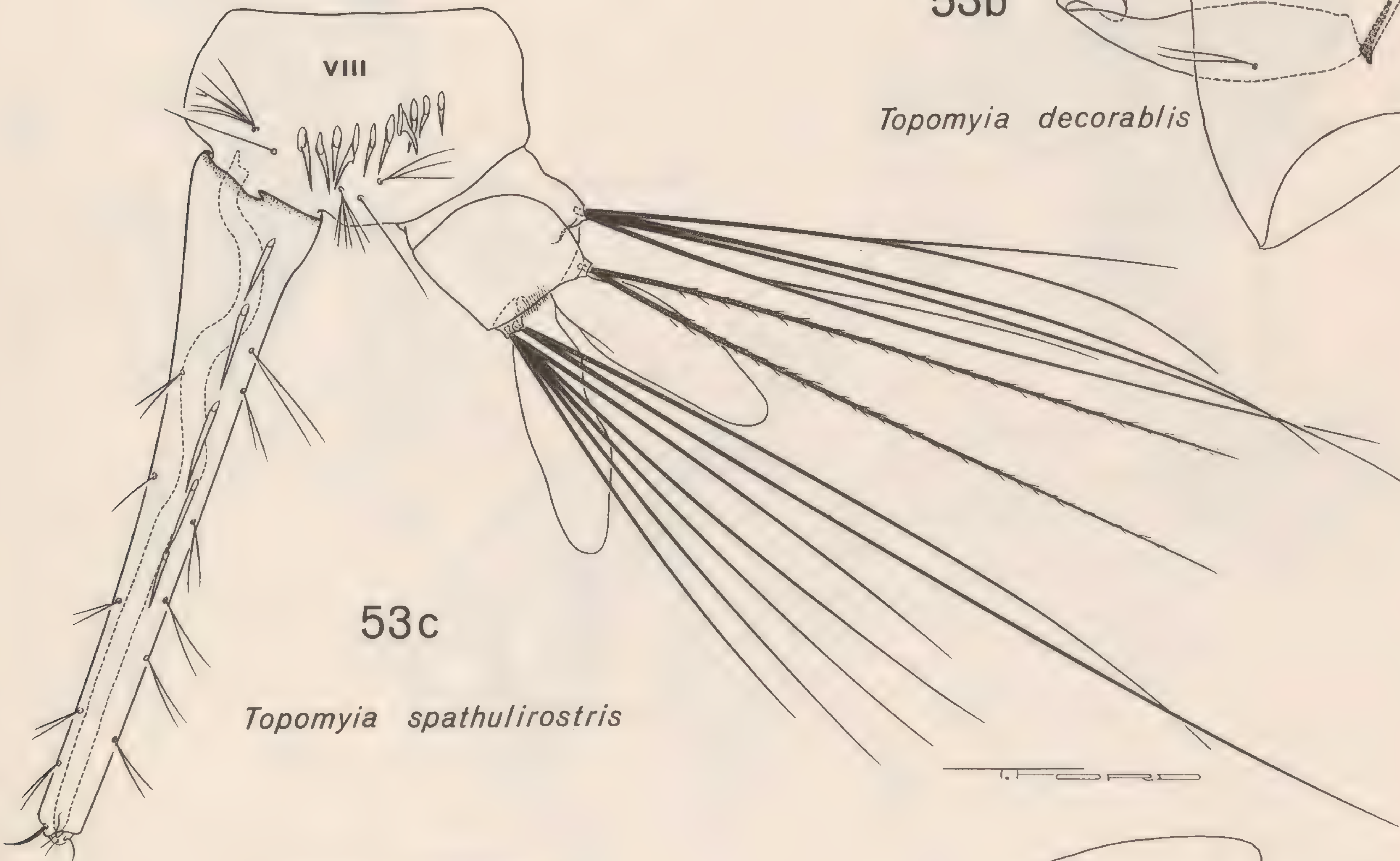
53a

Topomyia tenuis



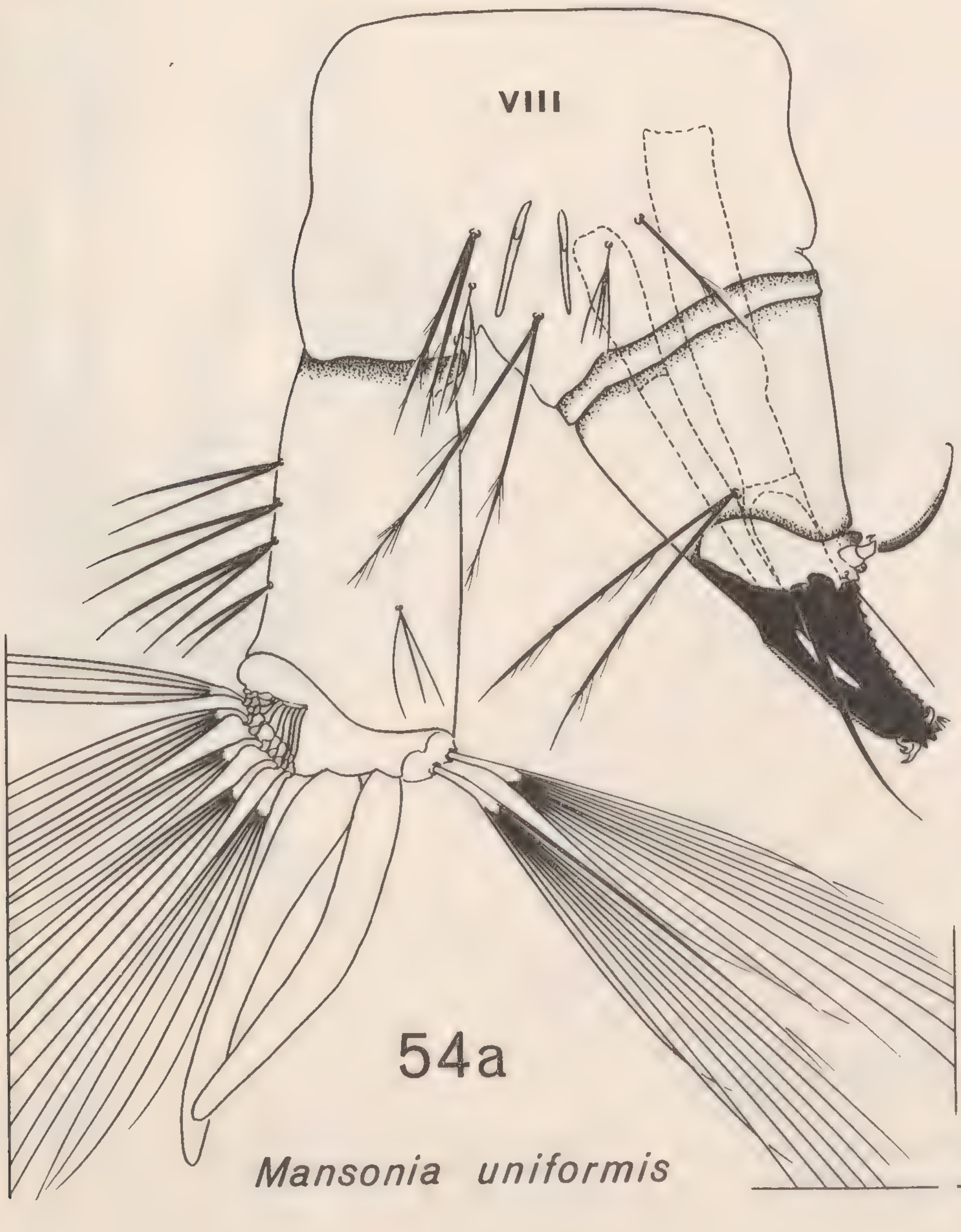
53b

Topomyia decorablis



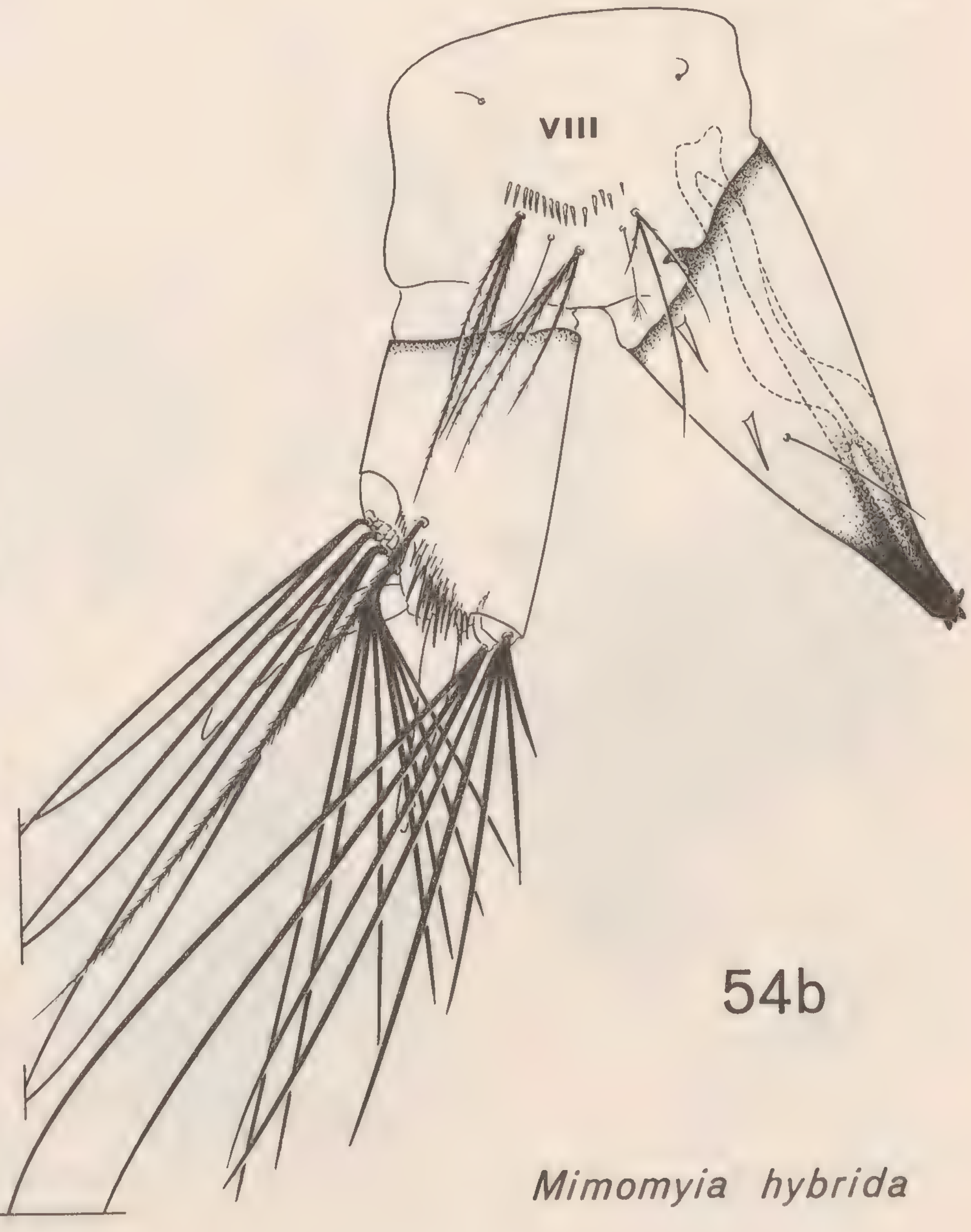
53c

Topomyia spathulirostris



54a

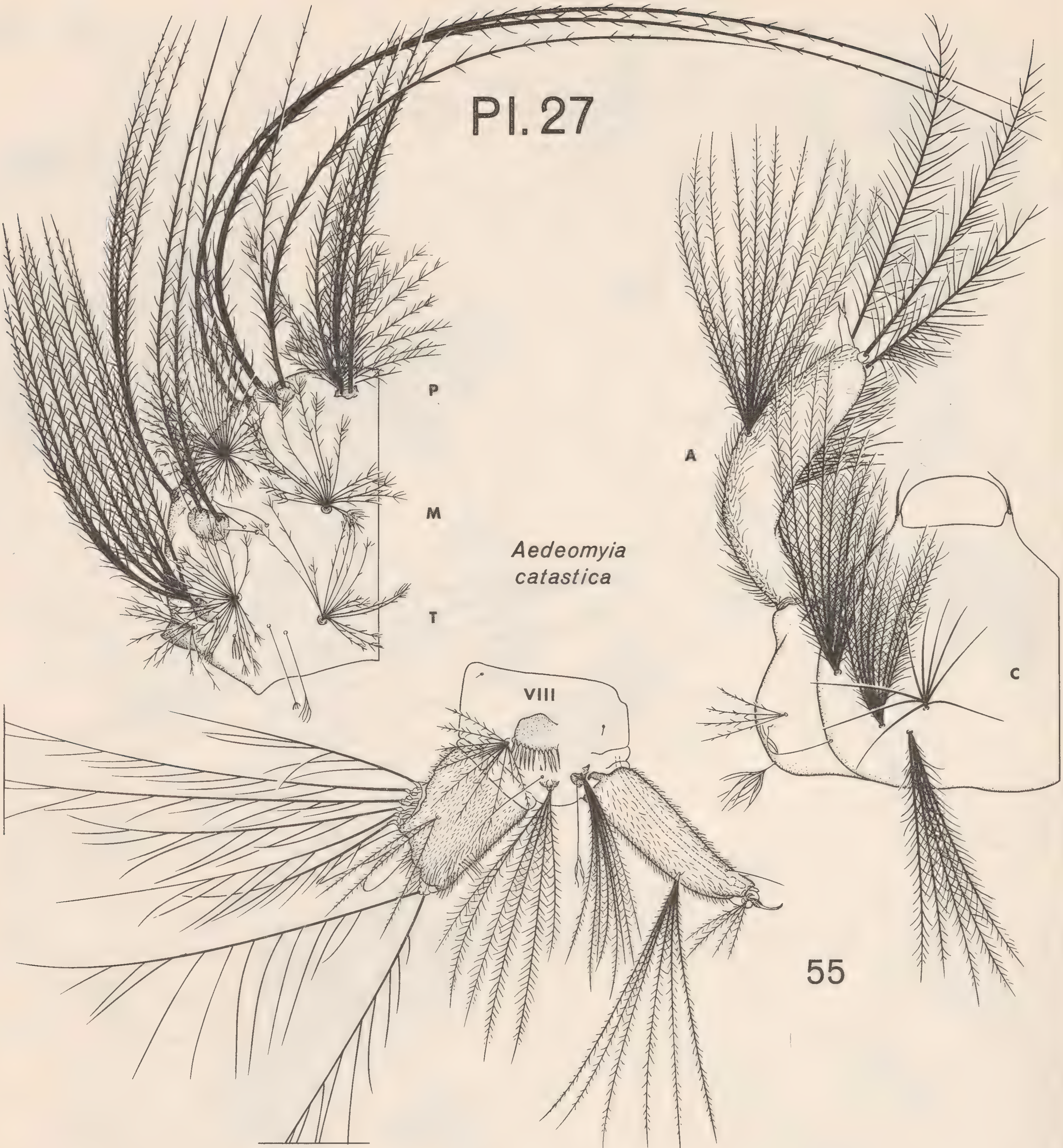
Mansonia uniformis



54b

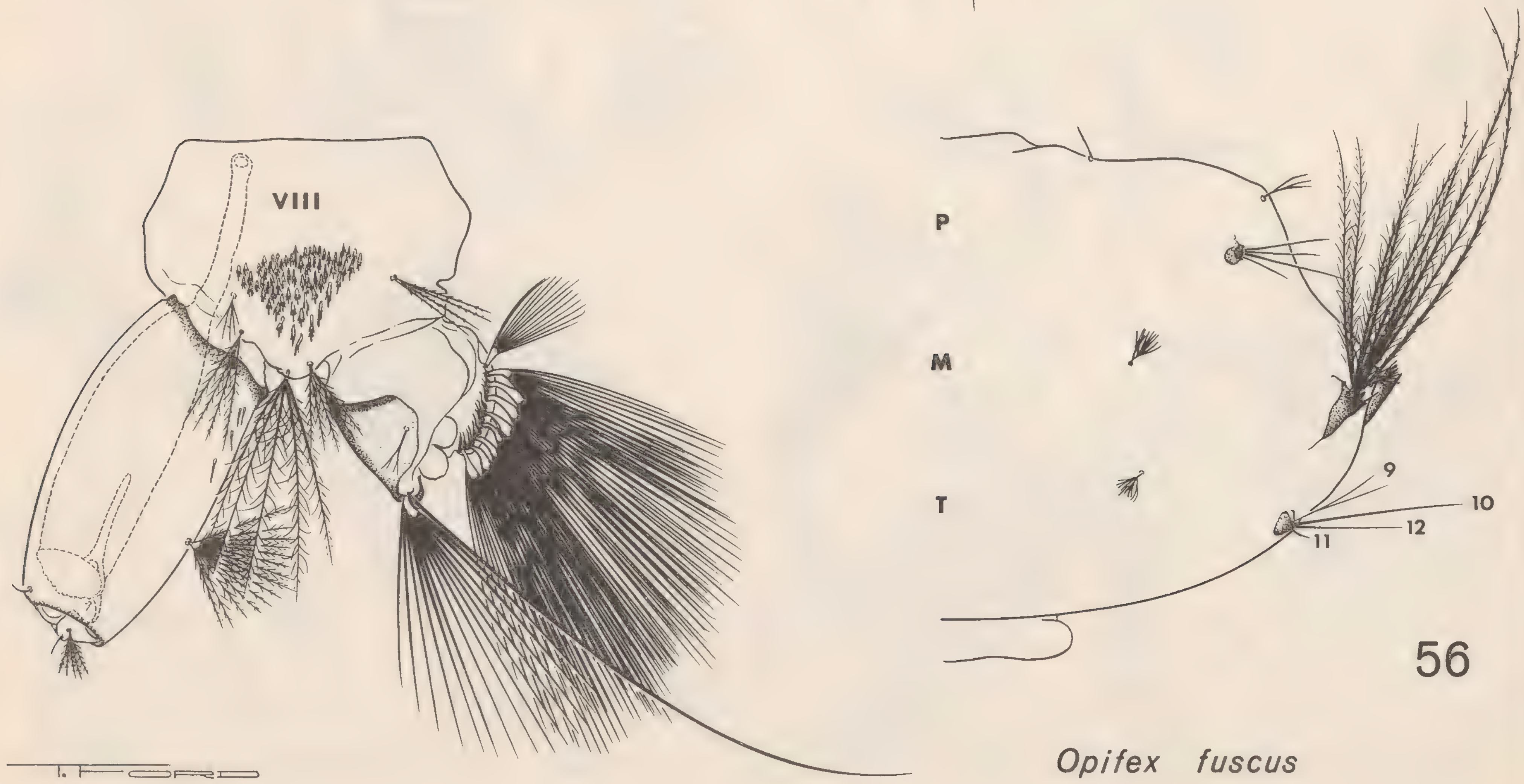
Mimomyia hybrida

Pl. 27



55

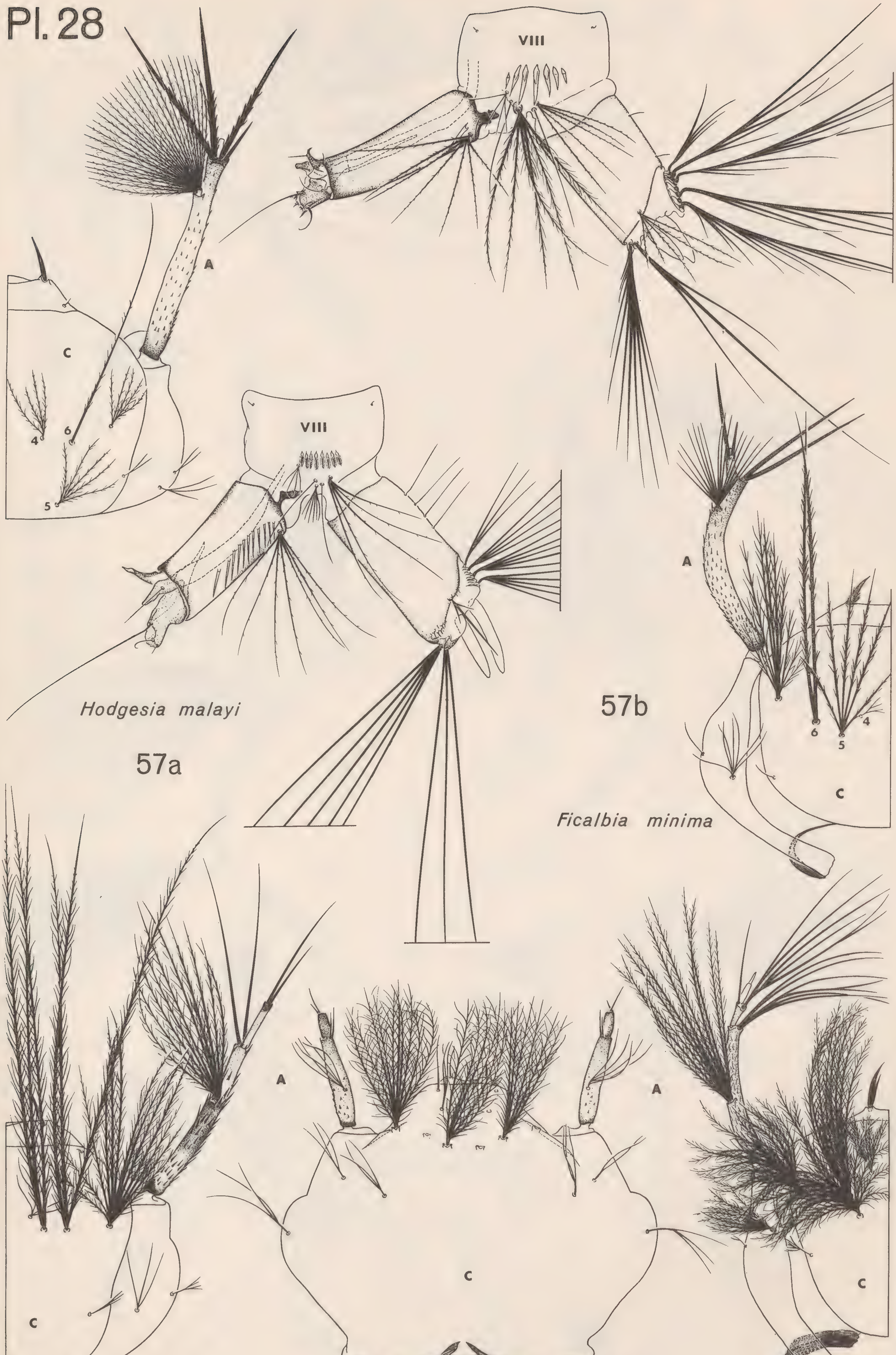
Aedeomyia catastica



56

Opifex fuscus

Pl. 28



57a
Hodgesia malayi

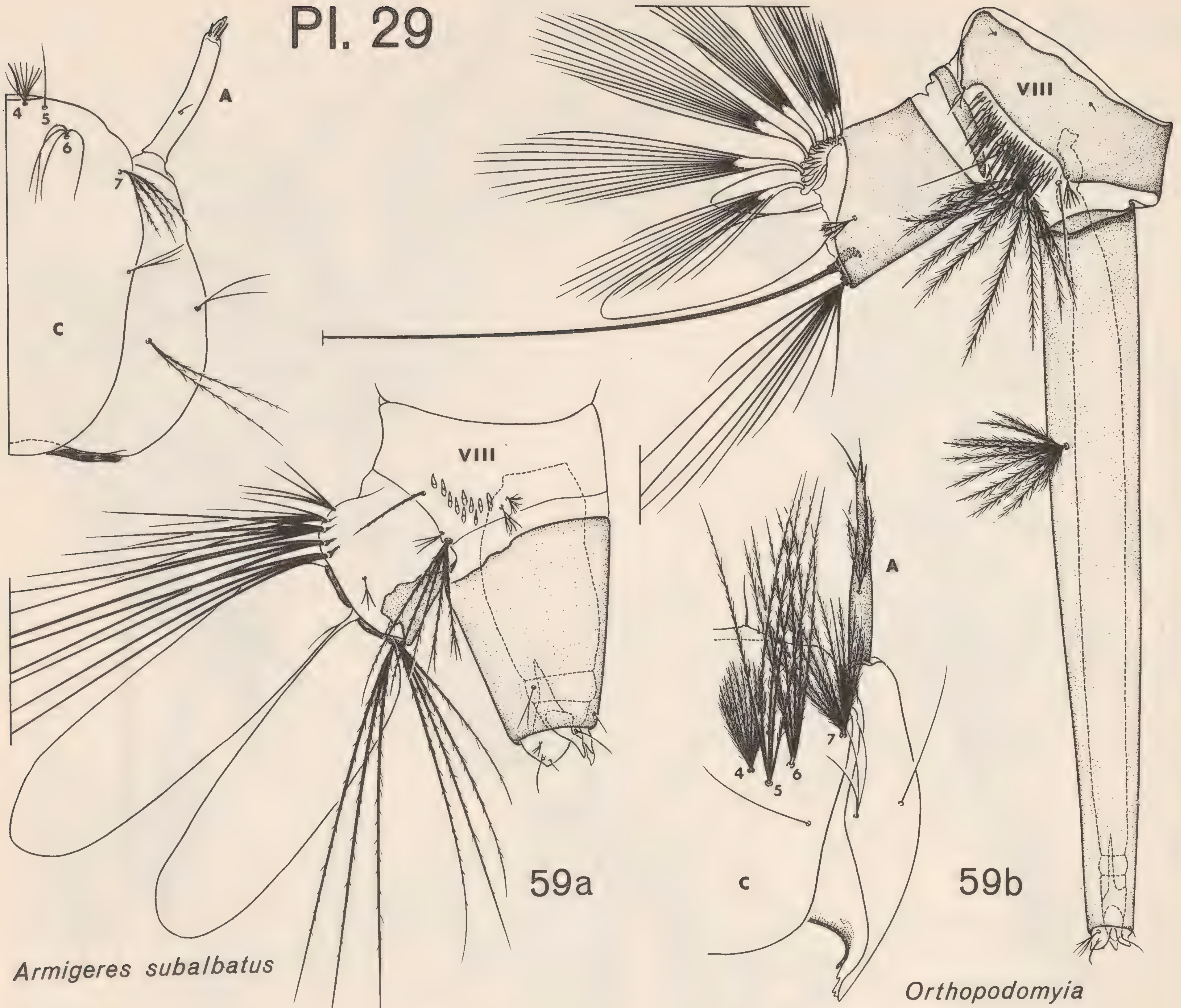
57b
Ficalbia minima

58a
M. (Mimomyia) chamberlaini

58b
M. (Mimomyia) plumosa

58c
M. (Ravenalites) deguzmanae

Pl. 29

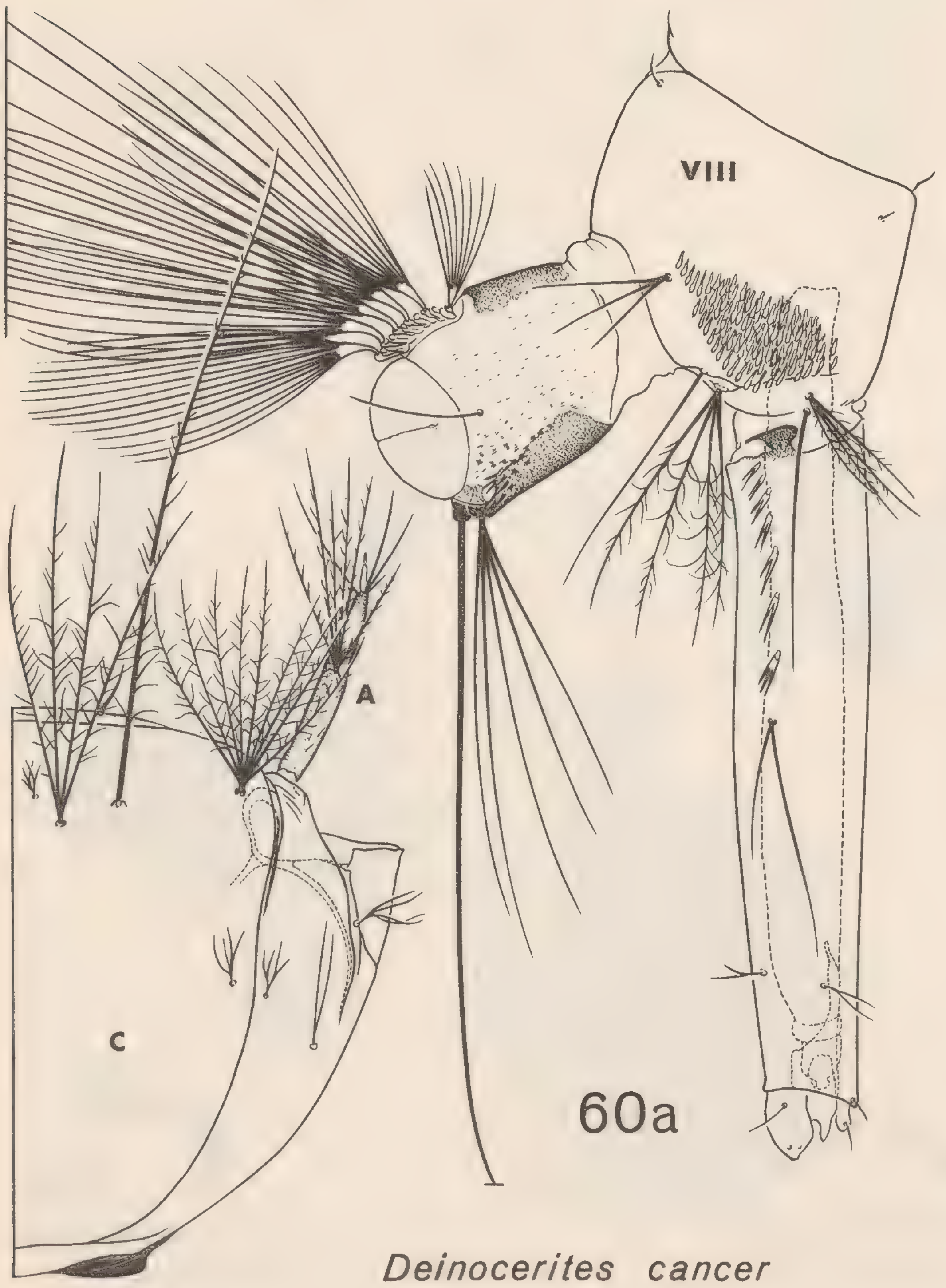


59a

Armigeres subalbatus

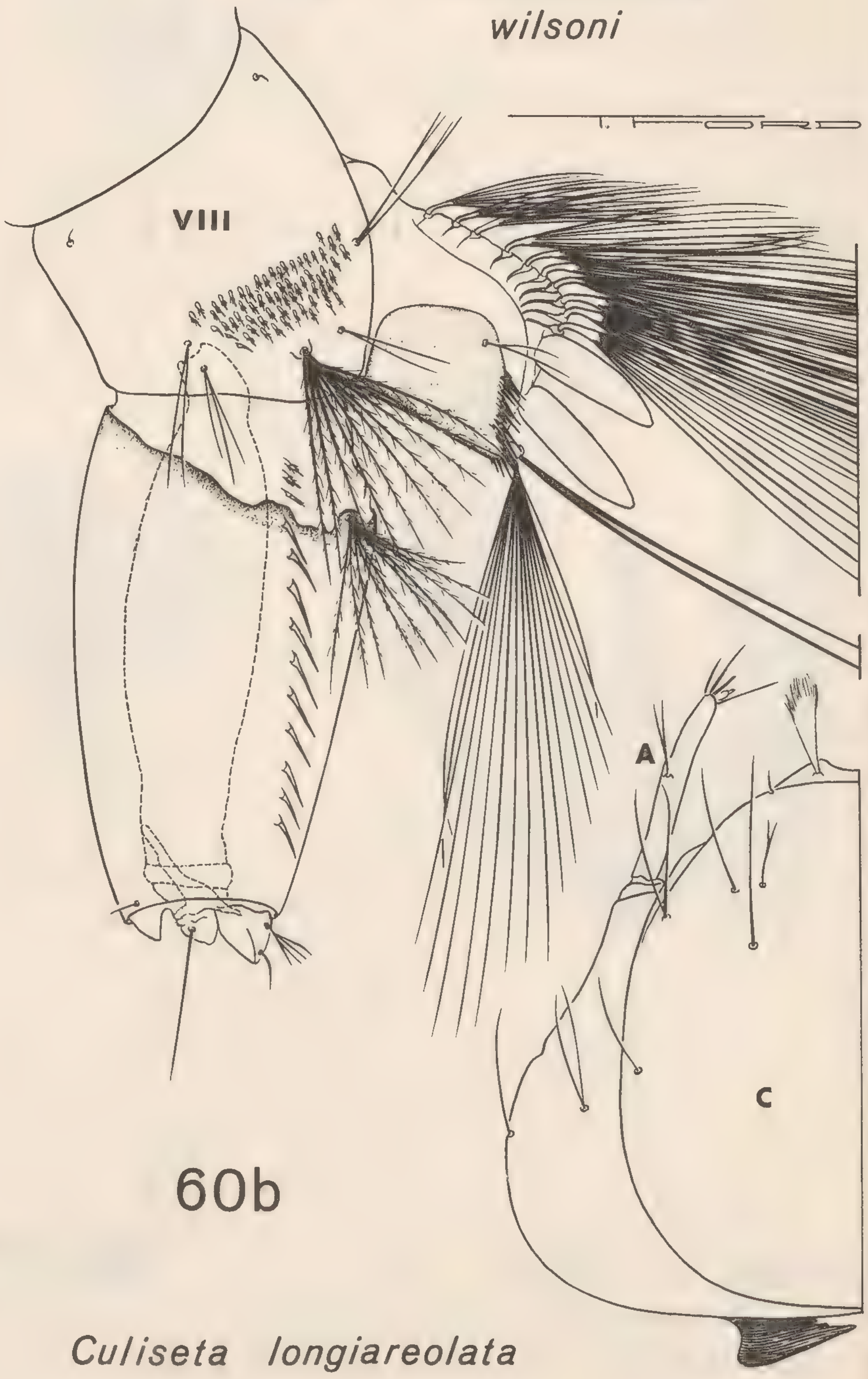
59b

Orthopodomyia wilsoni



60a

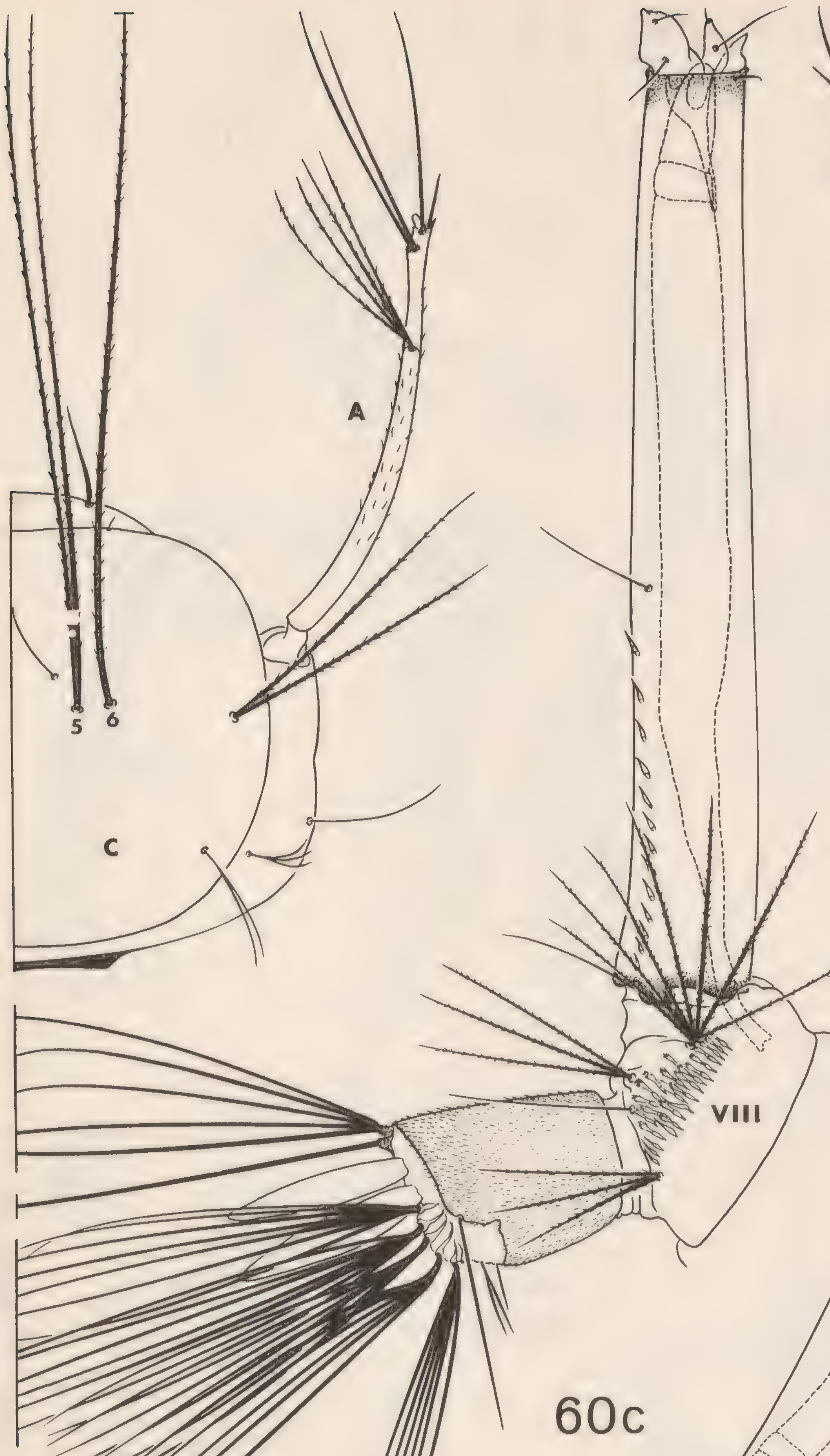
Deinocerites cancer



60b

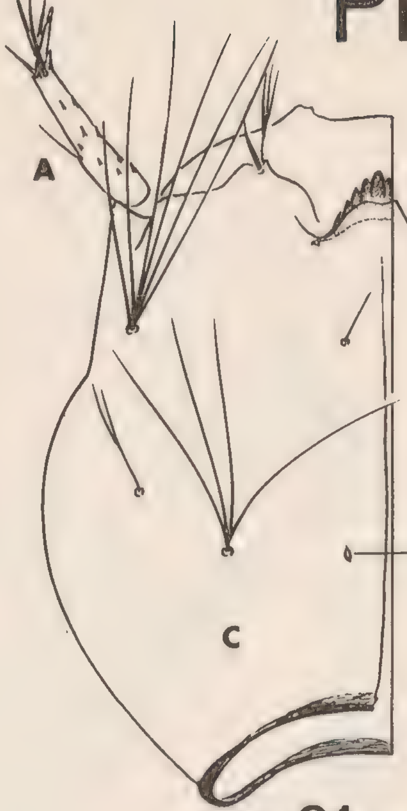
Culiseta longiareolata

Pl. 30



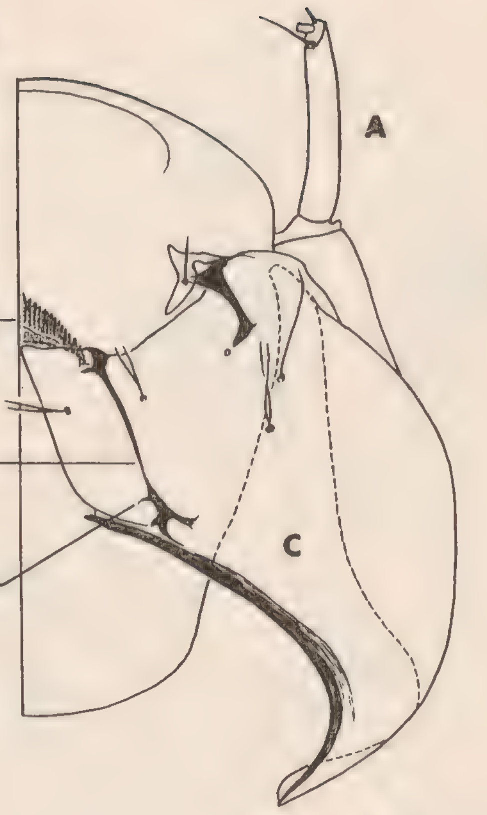
60c

Culiseta littleri



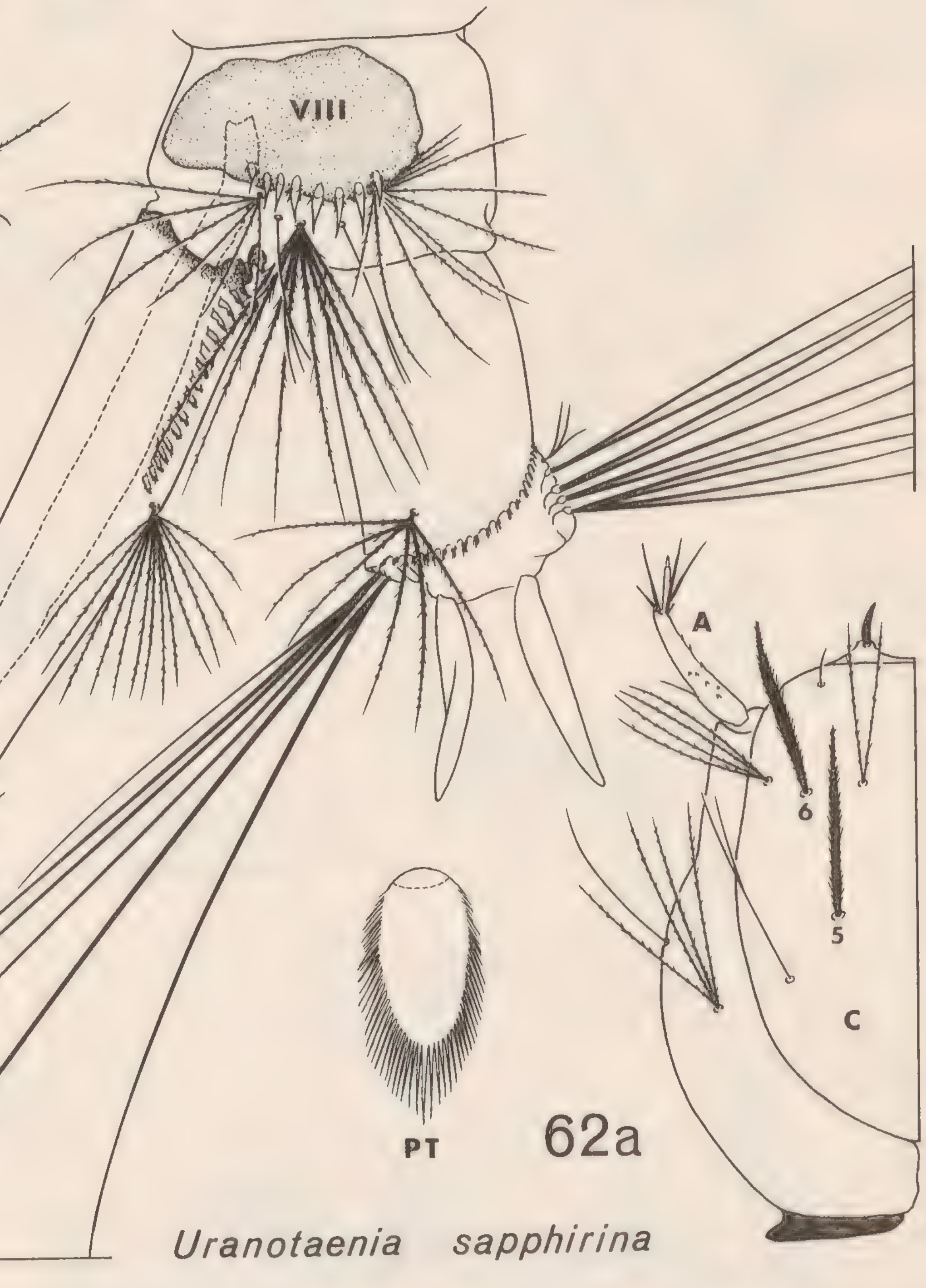
61a

Uranotaenia sapphirina



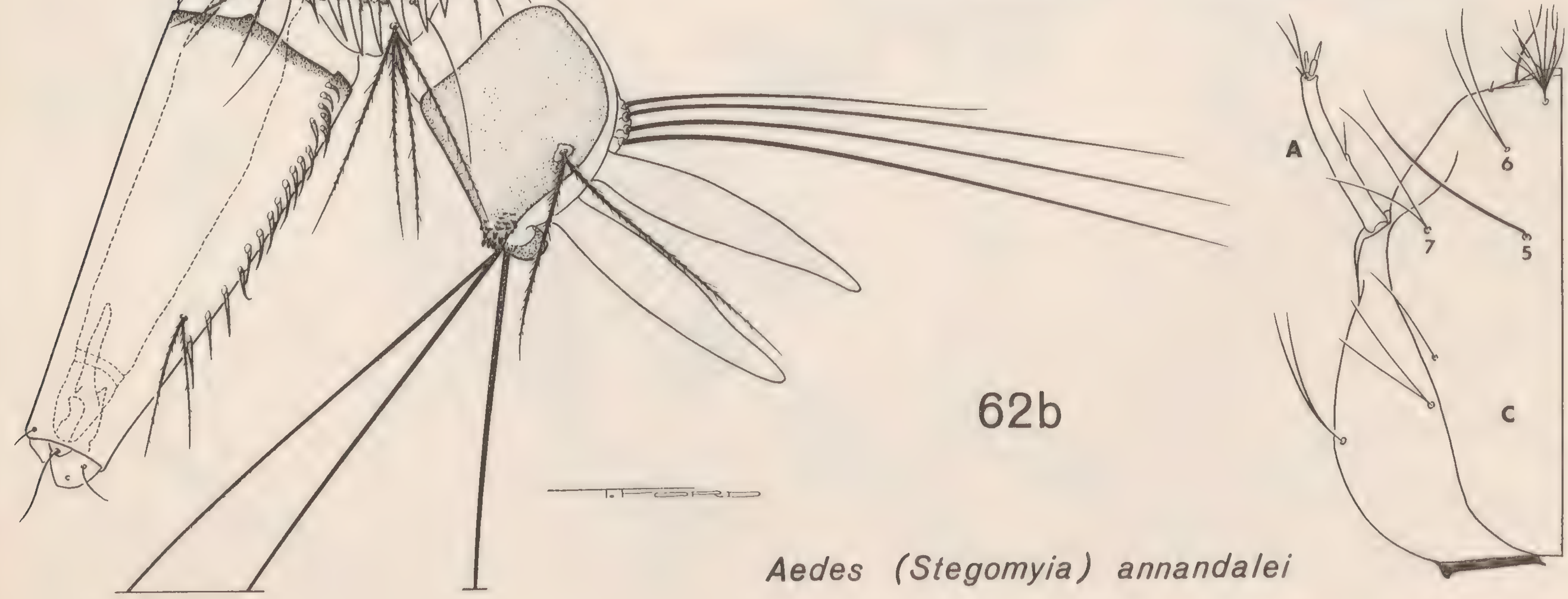
61b

Aedes aegypti



62a

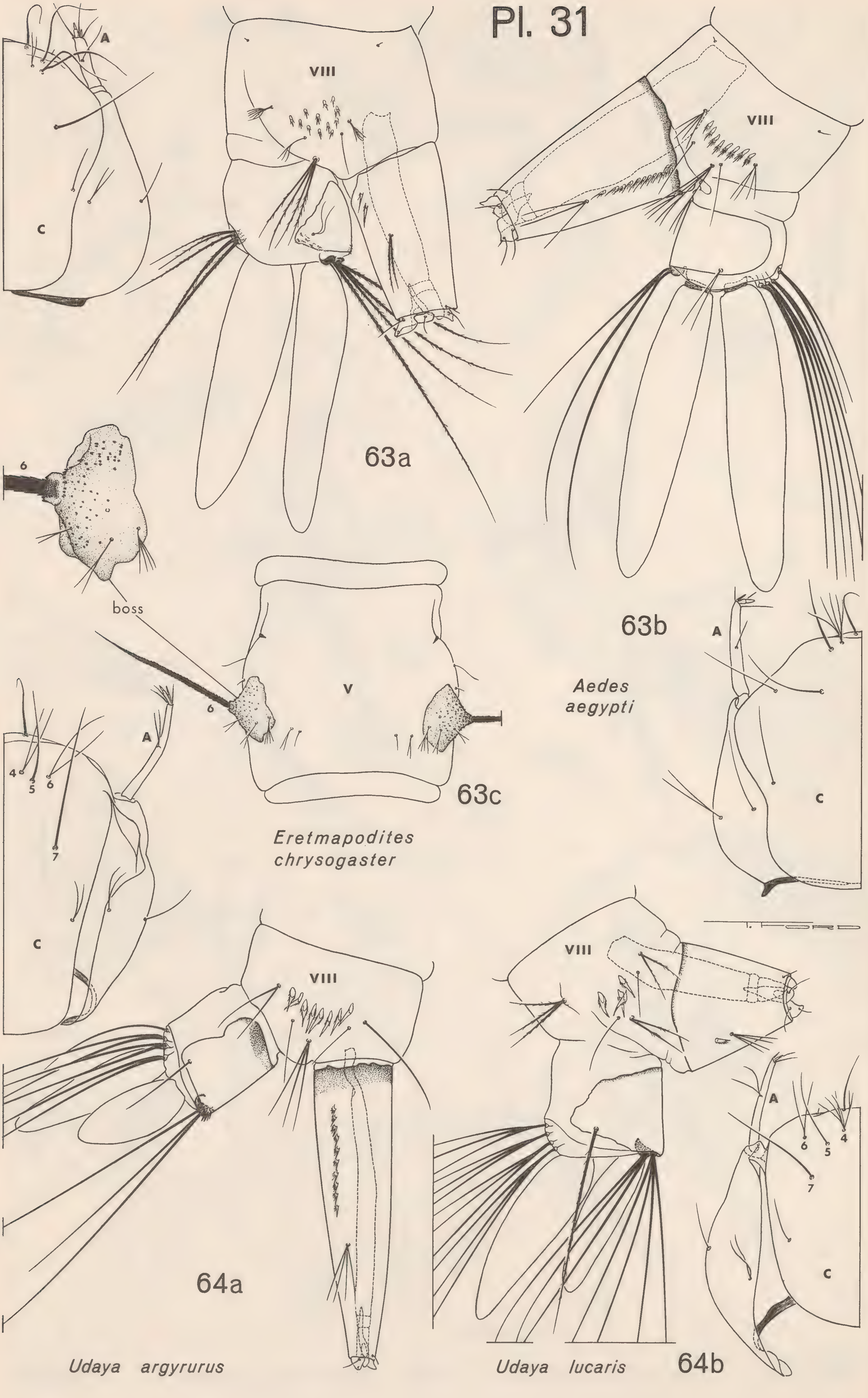
Uranotaenia sapphirina



62b

Aedes (Stegomyia) annandalei

Pl. 31



63a

63b

Aedes aegypti

63c

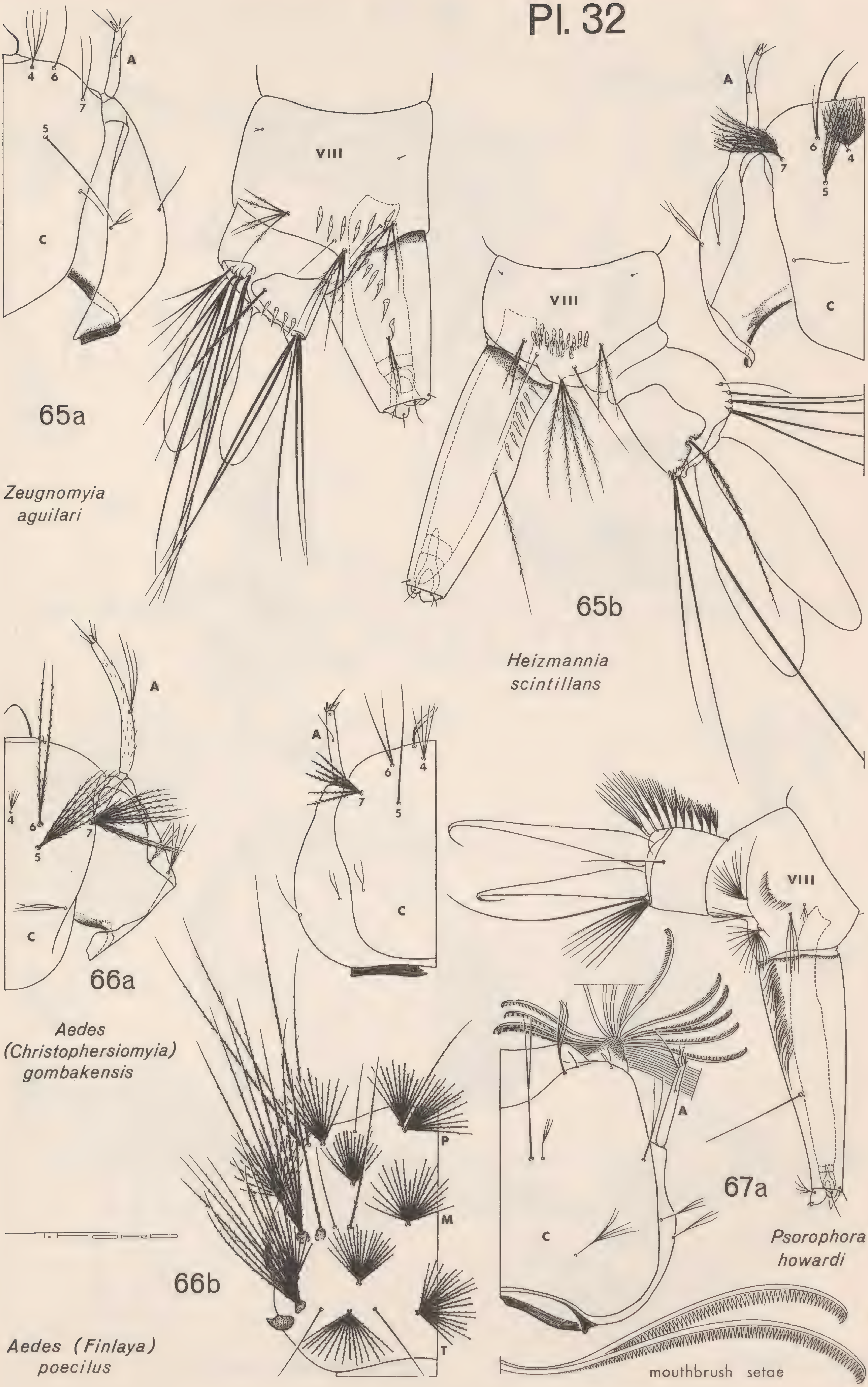
Eretmapodites chrysogaster

64a

Udaya argyrurus

Udaya lucaris 64b

Pl. 32



65a

Zeugnomyia aguilari

65b

Heizmannia scintillans

66a

Aedes (Christophersiomyia) gombakensis

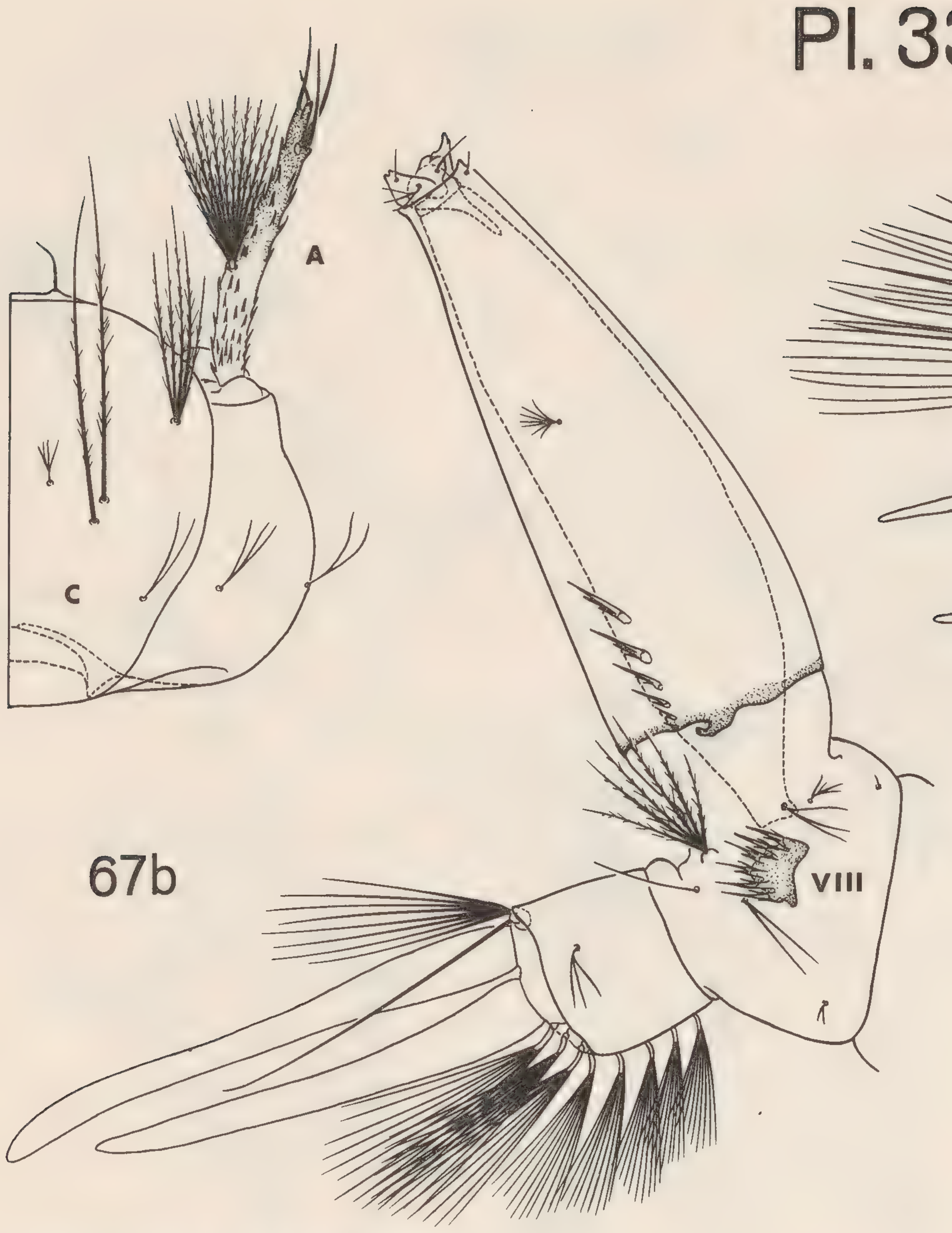
66b

Aedes (Finlaya) poecilus

67a

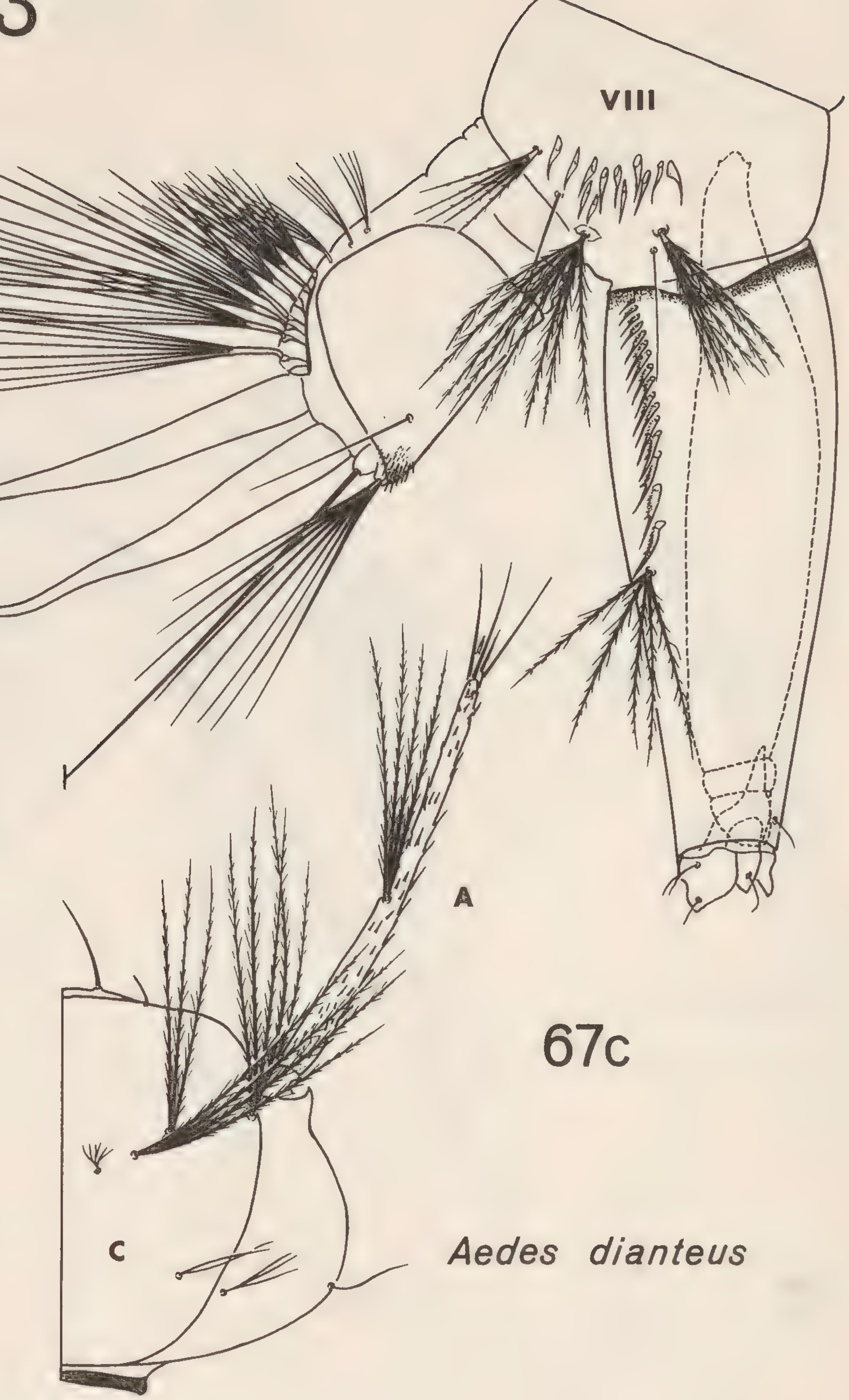
Psorophora howardi

Pl. 33



67b

Psorophora signipennis



67c

Aedes dianteus

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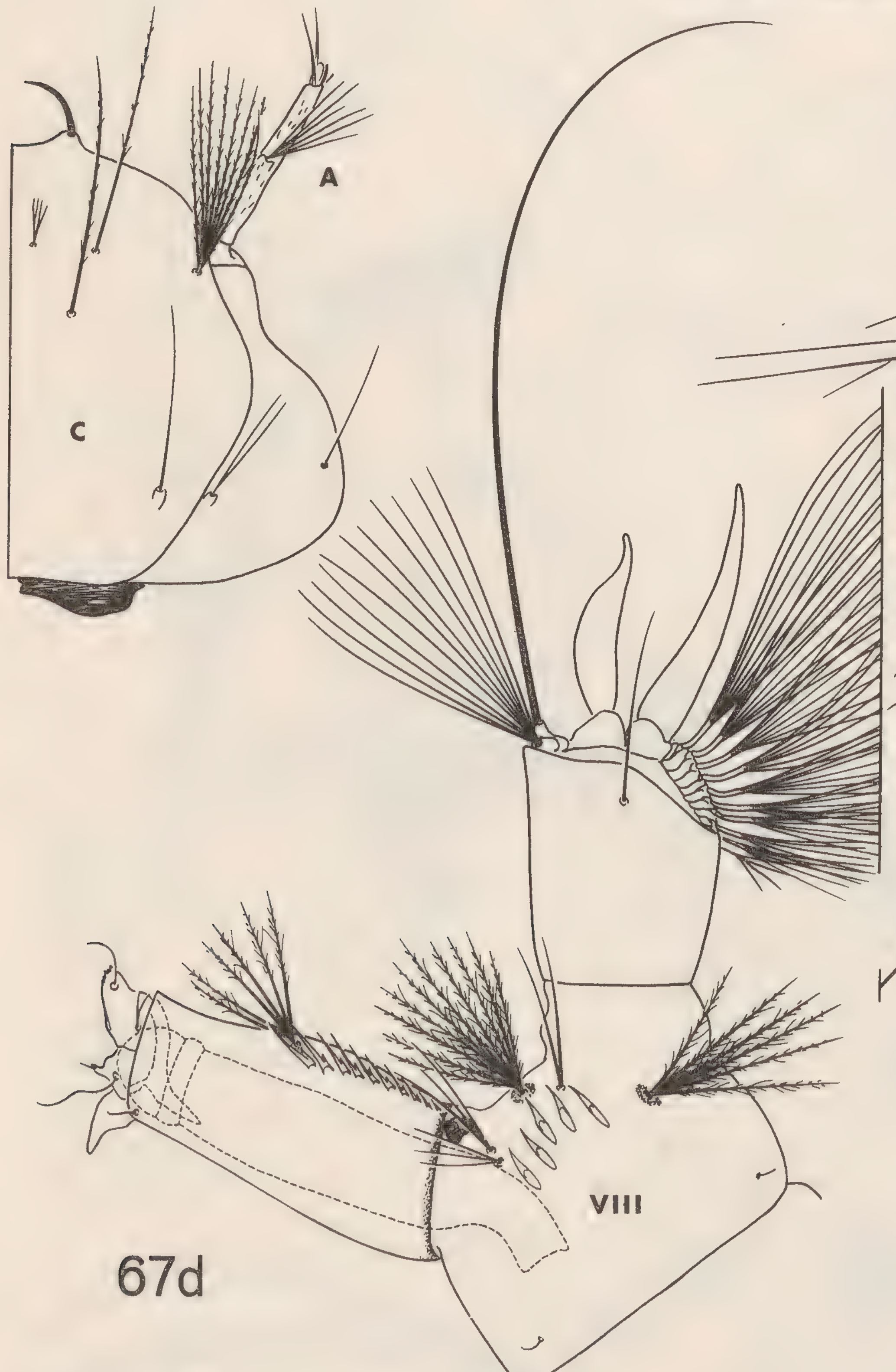
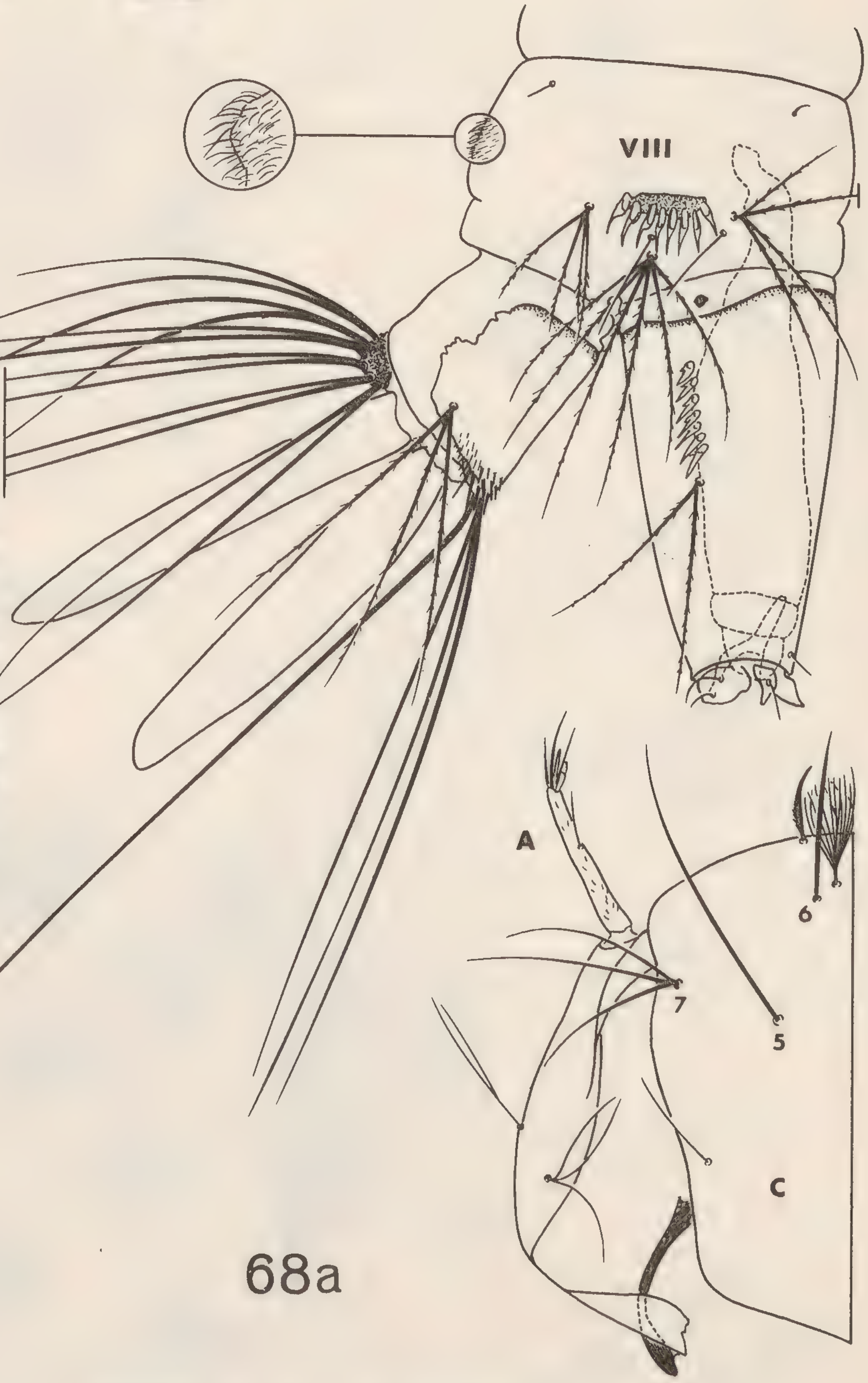


67d

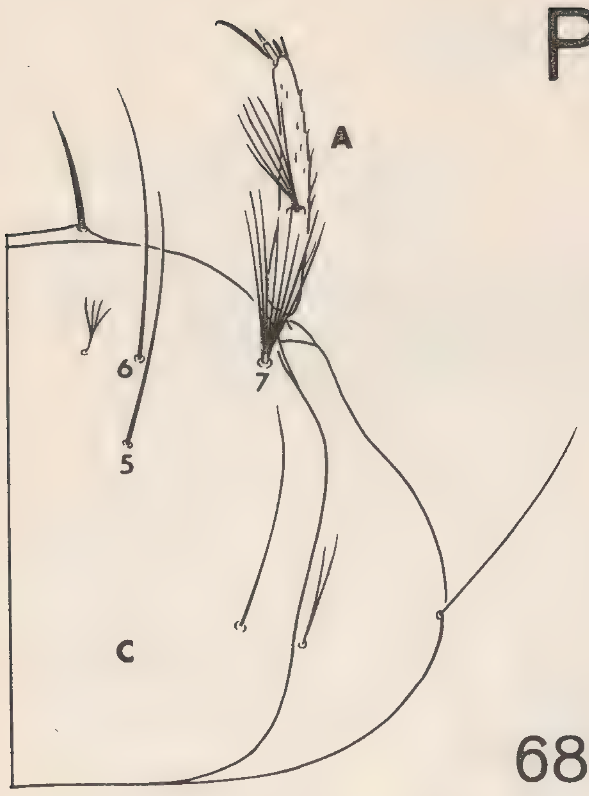
Aedes atlanticus

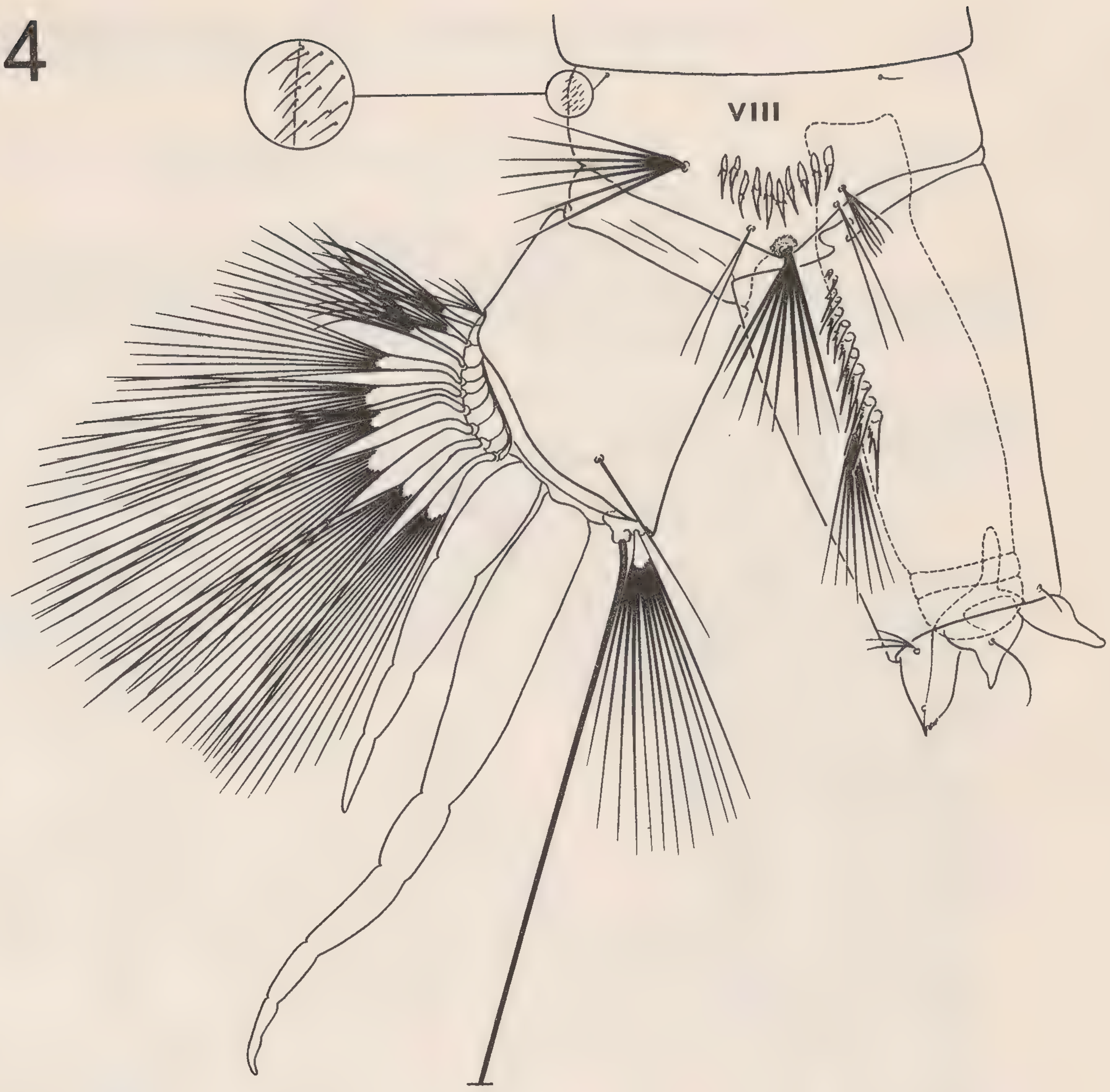


68a

Haemogogus capricornii

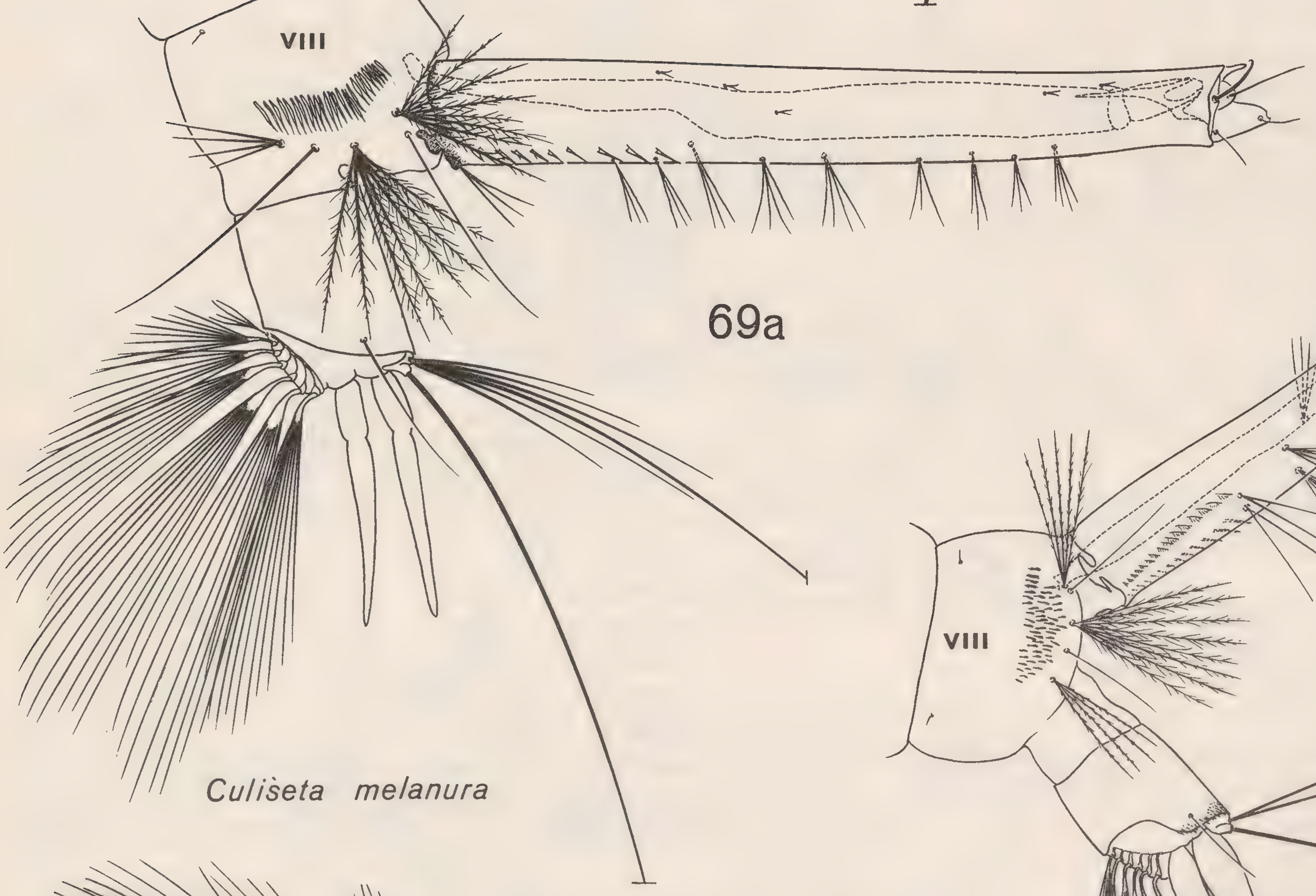
Pl. 34





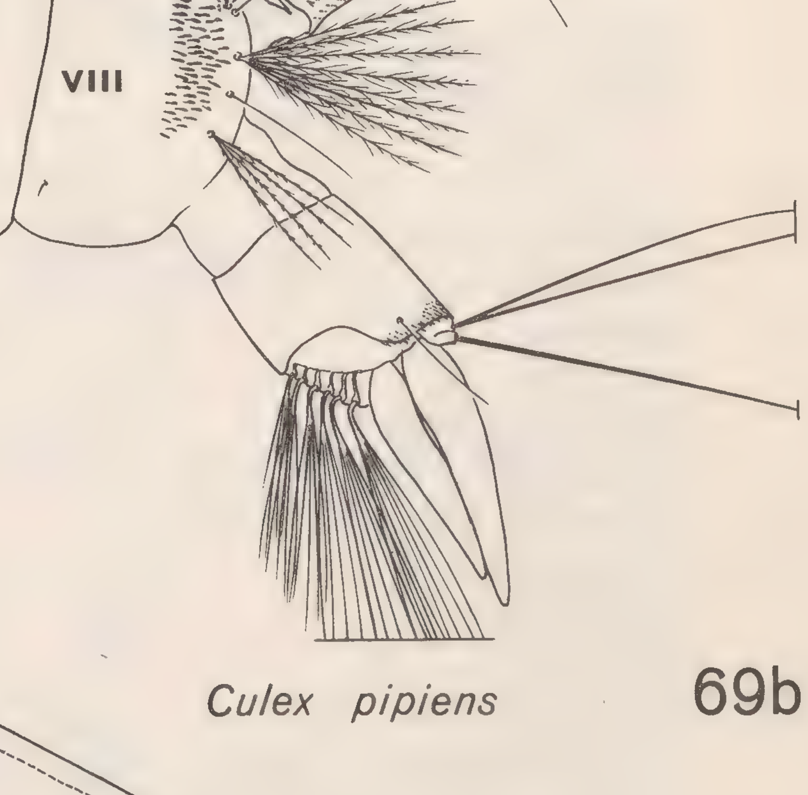
68b

Aedes serratus



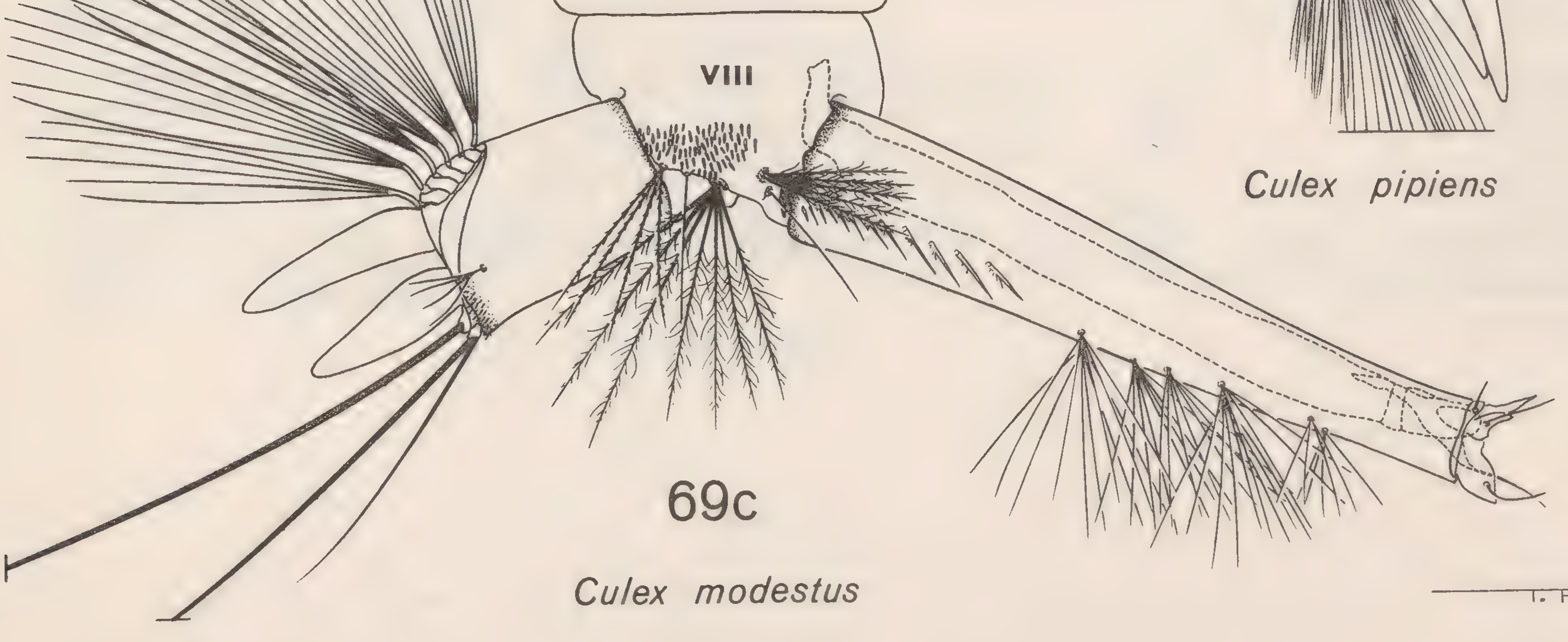
69a

Culiseta melanura



Culex pipiens

69b



69c

Culex modestus

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